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A Mechanical Pulse Recorder for Pulse Rate Tests

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INTRODUCTION

MEYLAN'S Test,[5]* Foster's Test,[2] Schneider's Test,[7] Campbell's Test,[1] The Michigan Pulse Rate Test,[6] and the California Group Functional Test [8]—all require an accurate determination of the pulse immediately after exercise. The customary method of determining the pulse rate is by palpation. However, because of the time often lost in locating the pulsations in the artery after exercise it is almost impossible to get an accurate count of the pulse immediately after exercise.

In an effort to overcome this difficulty, Hindman and Hamlin[3] constructed a device for counting the pulse immediately after exercise. The device consisted of an ordinary sphygmomanometer cuff which was wound around the arm. A friction joint and stopcock was added to permit removing the bulb during exercise. A rubber hose which led from the sphygmomanometer was attached to a tambour, and a kymograph record was obtained in the usual manner. Satisfactory records were obtained with a pressure of 20-50 mm Hg in the cuff.

A similar device was constructed by the writers. It was found that the device worked satisfactorily in giving any of the usual pulse tests. The cuff stayed on during exercise and did not slip about when the subject moved about. The pulse was clearly indicated on the kymograph recordings, and the count could be started a short time after the period of exercise. Some time, however, was lost in placing the subject's arm in position for recording and in getting the record started.

As a further investigation into the problem of securing an exact pulse count, several makes of sphygmographs were tried. None proved very successful; the instruments were hard to adjust, they slipped about continually, and the entire arrangement was cumbersome and hampered the subject during the period of exercise.

The Wiersma Hand Plethsymograph, which has been used in the Oberlin Psychological Laboratory for a number of years in recording

* Refer to numbered Bibliography at end of article.

the pulse during exercise, was also investigated. This proved most successful. The apparatus could be constructed at little cost, it was easy to adjust, it did not slip during exercise, and, most important of all, it gave a continuous pulse record—a pulse record before exercise, during exercise, and after exercise. The plethsymograms obtained made it possible to get the pulse immediately after exercise, or, for example, exactly five seconds after exercise as the Campbell Test requires. The records obtained also gave a permanent pulse record, which can be filed and kept for reference. A description of the Wiersma Hand Plethsymograph is here given in the hope that others will welcome it as an accurate, simple pulse recorder.

APPARATUS AND PROCEDURE

The plethsymograph differs from the sphygmograph, the usual pulse recorder, in that it depends upon the alterations in blood-volume, while the sphygmograph depends upon a spring pressing against an artery. In the main, the plethsymograph has been used in the study of blood-volume changes under varying conditions. Wiersma, however, has devised a plethsymograph for recording the pulse best. The pulse is obtained by simply recording the blood-volume changes in the hand. Technically, Wiersma's apparatus is a plethsymograph sphygmograph.

The general arrangement of the apparatus and the disposition of the subject is shown in Figure I. The plethsymograph proper is constructed from a 4¼″ section of bicycle tubing. The ends of the tubing are plugged with 1¼″ rubber corks, one cork solid and the other a ¼″ bore. Strips of adhesive tape are tightly wrapped around the ends of the tubing to keep the corks in position and to seal the ends. A piece of glass tubing, ¼″ in diameter, is inserted into the cork with the bore. The glass tubing is allowed to protrude from the cork about 1¼″ so pressure tubing can be attached to it.

Heavy pressure tubing is led from the glass tubing to the recording apparatus. (Figures I, T; II, T) The pneumodeik used to record the pulse (blood-volume change) was developed in the Oberlin Psychological Laboratory. A description of the deik has been published by Hudgins and Stetson.[4] A Marey tambour with a very light diaphragm may be substituted for the deik; it is not as stable and the membrane will have to be renewed on occasion.

A foot carpet contact is included in the set-up to indicate when the subject stops exercise. (Figure II, F.C.) A magnetic marker records each time the subject steps on the foot contact. (Figure II, M.M.) The marker is activated by a dry cell battery.

A Jacquet Timer is used for a time line. (Figure II, C) The timer is set to record in seconds.

A standard clockwork kymograph is used in making the recordings.

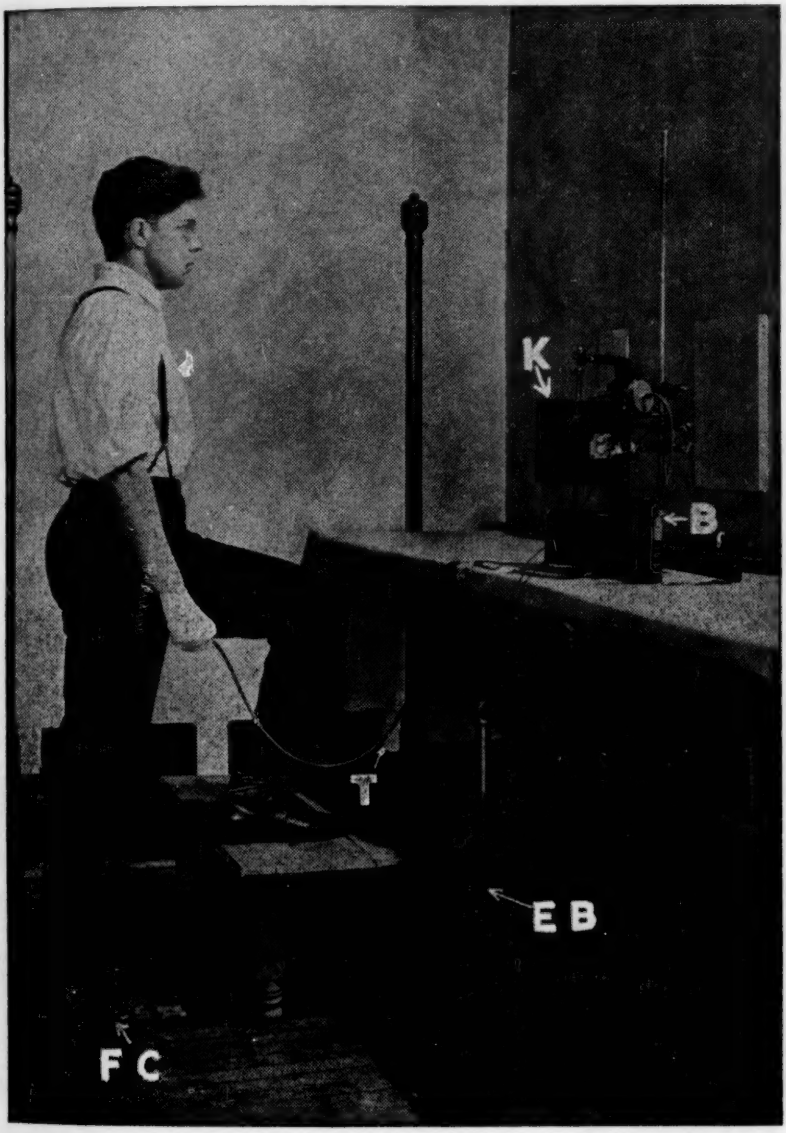

FIG. I. Arrangement of apparatus and disposition of subject: FC, foot contact; T, pressure tubing; EB, exercise bench for Campbell Pulse Ratio Test; K, kymograph; B, dry cell battery to activate magnetic marker.

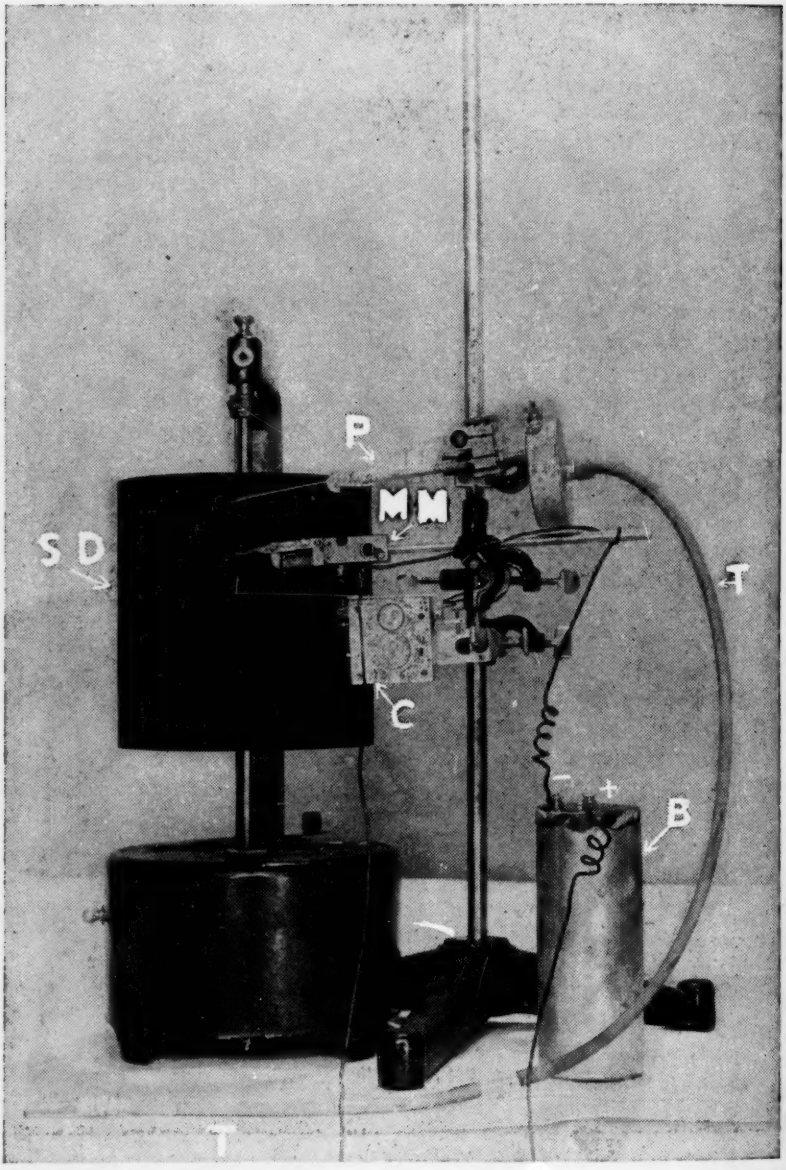

FIG. II. Recording apparatus: SD, smoked drum; P, pneumodeik; MM, magnetic marker; C, Jacquet chronoscope; B, dry cell battery; T, pressure tubing.

The speed is adjusted so that it takes about seven minutes for the drum to make one complete revolution. A 15 cm drum is most convenient as it permits recording two series of records and relieves the operator of having to change after every series. The drum is smoked in the usual manner. After the record is made, the smoked sheet is removed and run through a thin solution of shellac.

The subject grasps the plethsymograph (section of bicycle tubing) firmly in the fist. The chinks in the fist are filled with modeling clay, and the fist is then wrapped with adhesive tape. It is important that care

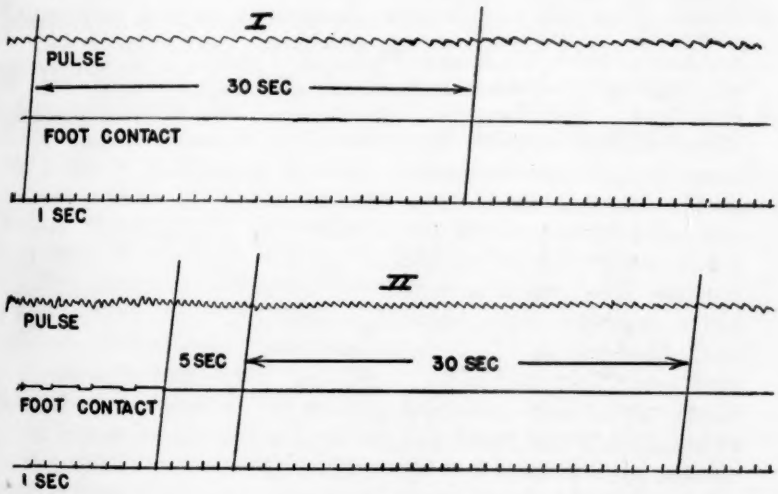

FIG. III. Kymograph record obtained for Campbell Pulse Ratio Test. Section I, normal pulse record with subject sitting; section II, pulse record during and after exercise.

be taken in wrapping the fist so that the subject is unable to move the fingers, else artifacts may appear in the record. When all is in readiness, the kymograph is started, the normal pulse records are secured for a period of two minutes. At the end of this period, the subject goes through the prescribed exercise, taking care to step on the foot contact each time with the same foot.* After the exercise is completed, the kymograph is allowed to continue for about three-and-one-half minutes more. From the record obtained, the normal pulse and the pulse after exercise can easily be obtained. Figure III is a photographic cut of the records obtained.

* The Campbell Pulse Ratio Test[1] was used for demonstration. This test requires taking the pulse with the subject sitting and again after the period of prescribed exercise. The exercise called for consists of mounting a stool 13″ high at the rate of 28 times per minute. The sequence in mounting and dismounting was left foot up, right foot up, left foot down, right foot down and upon foot contact. (Figure 1)

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Tables Predicting the Advent of the Menarche From Height and Weight

By Frank K. Shuttleworth
Yale University

THE writer has recently observed the psychological reactions of two girls to the advent of their first menstruation or menarche. The parents of one girl anticipated an early first menstruation and made the necessary preparations. When the event occurred at age ten and a half, this girl helped herself to her mother's sanitary pads and no one was the wiser for several days. Her reaction was one of secret pride in growing up so soon. Subsequent menstrual intervals have been regular and have not interfered in the least with normal activities. A second girl, best chum of the first, experienced her first menstruation in the same week as the first but at age thirteen and a half. In complete ignorance of the existence of any such function, she was terribly frightened, became hysterial, could not be reassured by parents or family physician, was physically ill for two weeks, and out of school for four weeks. Subsequent menstrual periods have been regular, but accompanied by acute psychological depressions. Cases may, of course, be selected to illustrate any thesis, but it ought not to require a rigidly controlled scientific study to demonstrate the psychological damage which may be created by an unanticipated first menstruation. It is hoped that tables predicting the advent of the menarche may be of some value in alleviating this problem.

BACKGROUND FACTS

At the outset certain general background facts need to be noted. In representative American populations, from 1 per cent to 4 per cent of girls menstruate prior to their eleventh birthday, from 27 per cent to 36 per cent menstruate between their thirteenth and fourteenth birthdays, and from 4 per cent to 8 per cent menstruate after their fifteenth birthday.[1,2,3]* The advent of the menarche as early as age nine or as late as age seventeen is neither rare nor necessarily abnormal. Seasonal, climatic, dietary, socio-economic, urban-rural, and racial factors accelerate or retard the menarche significantly when many cases are averaged,[2,4] but hereditary factors are much more important.[5,6,7,8] Petri, for example, has reported a median difference of only 2.8 months between the menarcheal ages of 51 pairs of identical twin sisters. The comparable difference for fraternal twin sisters is 12.0 months, for

* Numbers refer to Bibliography at end of article.

ordinary sisters 14.4 months, for mothers and daughters 18.4 months, and for cases paired at random from the general population 18.6 months. Standard deviations and correlations are not reported by Petri, but the writer estimates that the correlation for identical twin pairs is between .93 and .97. The correspondence in the menarcheal ages of the identical twins is very high in the light of the fact that even the second menstrual period cannot be predicted with precision from knowledge of the first. From an analysis of original data of Engle and Shelesnyak[2] on 141 girls, the writer finds the correlation between ages at first and second menstruation to be .983 and the probable error of estimate of the second menstruation from the first to be 1.4 months. Since the immediately effective factors determining the advent of the menarche are in the endocrine organization of the individual and especially the pituitary,[9] the data of Petri suggest that age at the initiation of increased endocrine activity is also determined in large part by hereditary factors. The important relationship for our present purpose, however, is that the hormones of the pituitary have growth-stimulating as well as gonad- or sex-stimulating properties. Hence, it is supposed that the process of sexual maturation and of accelerated physical growth are initiated at approximately the same time in a given individual, but at widely different ages in different individuals. It follows that there are very striking differences in the physical growth patterns of girls who menstruate at different ages. These contrasting growth patterns can be used to predict the advent of the first menstruation. The four sets of curves in Figure I, redrawn from a study by the writer,[10] will illustrate the most essential points. The upper lefthand section gives the growth curves in average standing height of 22 girls who menstruated before age 11–6 (solid curve) and of 18 girls who menstruated after age 14–5 (broken curve). At age 12.0 there is a difference of five inches. Or, in terms of individuals rather than groups there is correlation at age 12.0 based on 238 cases of −.473 between standing height and menarcheal age. The comparable chart for weight at the upper right shows a difference of thirty-eight pounds between the two groups at age 13.0. Here the correlation is −.517. It is apparent from these charts that more or less accurate predictions of menarcheal age can be made from standing height and weight throughout the age range from seven to eighteen. The corresponding annual gains in standing height and weight are presented at the bottom of Figure I. Gains in height of the early maturing group of girls for the year ending at age 11.0 average over three inches while those of the late maturing group average less than two inches. Here the correlation between annual increments and menarcheal age is −.549 while at age 14.0 the correlation is .705. Similar relationships hold in the case of body weight. These findings suggested the practical problem of predicting the advent of the menarche.

PRACTICAL PREDICTION TABLES*

Tables I and II record expected menarcheal ages in years and months for various combinations of height, weight, and annual gains in height during the period from age ten to fourteen. Table I is read as follows: Girls 63 inches tall and weighing 110 pounds at their tenth birthday will menstruate on the average at age 11–6 (eleven years, six

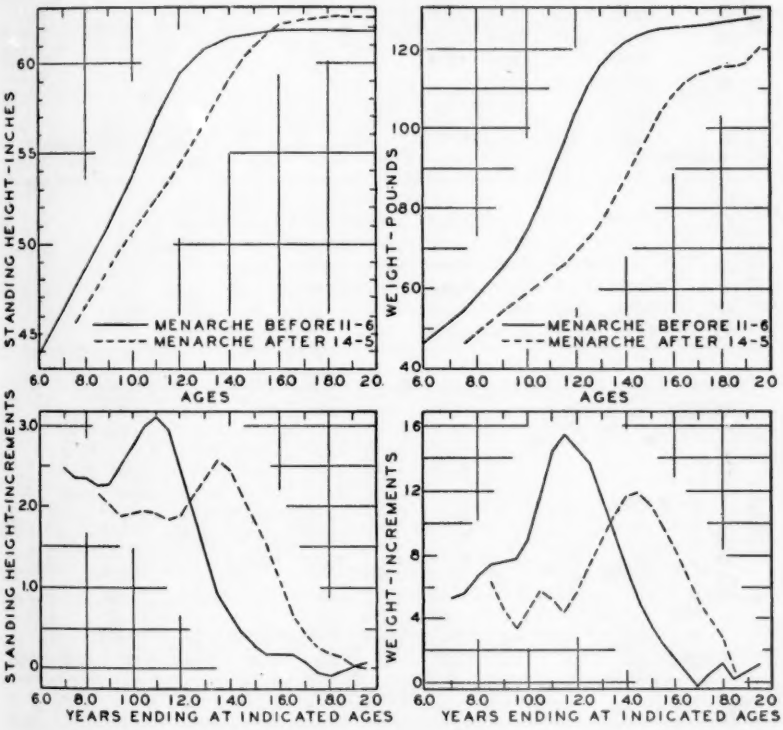

FIG. I. Average standing heights and average body weights and corresponding annual increments in standing height and body weight of girls menstruating before age 11–6 and after age 14–5.

months, zero days). The same stature and weight at the eleventh birthday indicates the advent of the menarche at age 11–8. The same stature and weight at age ten and a half indicates the advent of the menarche at age 11–7 (the average of predictions for ages 10 and 11). It is important, of course, that any program of instruction in the hygiene of the menstrual function actually anticipate the advent of the menarche and in this connection it must be emphasized that a

* Acknowledgments are due to the Works Progress Administration of Connecticut (Project 465-15-3-12) for clerical help and to Mrs. Mary Colton Ingham for most of the statistical computations.

TABLE I

MENARCHEAL AGE IN YEARS AND MONTHS PREDICTED FROM STANDING HEIGHT (INCHES) AND WEIGHT (POUNDS) AT EACH AGE FROM TEN TO FOURTEEN.

Age 10 (9.5 to 10.49); R, .37; P.E. estimate, 7.3 months

Height \ Weight:	40	50	60	70	80	90	100	110
63				12–4	12–2	11–11	11–8	11–6
60			12–9	12–6	12–3	12–1	11–10	11–8
57		13–1	12–11	12–8	12–5	12–3	12–0	11–9
54	13–6	13–3	13–1	12–10	12–7	12–5	12–2	
51	13–8	13–5	13–2	13–0	12–9	12–6		
48	13–9	13–7	13–4	13–2	12–11			
45	13–11	13–9	13–6	13–4				
42	14–1	13–11	13–8					

Age 11 (10.50 to 11.49); R, .49; P.E. estimate, 7.1 months

Height \ Weight:	50	60	70	80	90	100	110	120	130
63					12–2	11–11	11–8	11–5	11–2
60				12–7	12–4	12–1	11–11	11–8	11–4
57			13–0	12–9	12–7	12–4	12–1	11–10	
54		13–6	13–3	13–0	12–9	12–6	12–3		
51	13–11	13–8	13–5	13–2	12–11	12–8			
48	14–1	13–10	13–8	13–5	13–2				
45	14–3	14–1	13–10	13–7					

Age 12 (11.5 to 12.49); R, .53; P.E. estimate, 6.9 months

Height \ Weight:	50	60	70	80	90	100	110	120	130	140
66				12–7	12–4	12–2	11–11	11–9	11–7	11–4
63				12–9	12–7	12–4	12–2	12–0	11–9	11–7
60			13–2	13–0	12–9	12–7	12–5	12–2	12–0	11–9
57		13–7	13–5	13–2	13–0	12–10	12–7	12–5	12–2	
54		13–10	13–8	13–5	13–3	13–0	12–10	12–8		
51	14–3	14–1	13–10	13–8	13–5	13–3	13–1			
48	14–6	14–3	14–1	13–10						

Age 13 (12.5 to 13.49); R, .52; P.E. estimate, 7.0 months

Height \ Weight:	50	60	70	80	90	100	110	120	130	140	150
69					12–11	12–9	12–6	12–3	12–0	11–9	11–6
66				13–4	13–1	12–10	12–7	12–4	12–1	11–10	11–7
63				13–5	13–2	12–11	12–8	12–5	12–2	11–11	11–8
60			13–9	13–6	13–3	13–0	12–9	12–6	12–3	12–0	11–9
57		14–1	13–10	13–7	13–4	13–1	12–10	12–7	12–4	12–1	
54		14–2	13–11	13–8	13–5	13–2	12–11	12–8			
51	14–6	14–3	14–0	13–9							
48	14–7	14–4									

Age 14 (13.5 to 14.49); R, .41; P.E. estimate, 7.5 months

Height \ Weight:	60	70	80	90	100	110	120	130	140	150	160
69				13–7	13–4	13–2	12–11	12–8	12–5	12–2	11–11
66			13–9	13–6	13–4	13–1	12–10	12–7	12–4	12–2	11–11
63			13–8	13–6	13–3	13–0	12–9	12–6	12–4	12–1	11–10
60		13–10	13–8	13–5	13–2	12–11	12–8	12–5	12–3	12–0	
57	14–0	13–10	13–7	13–4	13–1	12–10	12–8	12–5	12–2	11–11	
54	14–0	13–9	13–6	13–3	13–0						
51	13–11	13–8	13–5								

TABLE II

MENARCHEAL AGE IN YEARS AND MONTHS PREDICTED FROM ANNUAL GAIN IN STANDING HEIGHT (INCHES) AND FROM WEIGHT (POUNDS) AT EACH AGE FROM TEN TO FOURTEEN.

Age 10 (9.5 to 10.49); R, .51; P.E. estimate, 6.8 months

Height Gain \ Weight:	40	50	60	70	80	90	100	110
4.0			11-7	11-5	11-3	11-0	10-10	10-8
3.5		12-3	12-0	11-10	11-8	11-5	11-3	11-1
3.0		12-8	12-5	12-3	12-0	11-10	11-8	11-5
2.5		13-0	12-10	12-8	12-5	12-3	12-1	11-10
2.0	13-8	13-5	13-3	13-1	12-10	12-8	12-6	12-3
1.5	14-0	13-10	13-8	13-5	13-3	13-1		
1.0	14-5	14-3	14-1	13-10				

Age 11 (10.5 to 11.49); R, .63; P.E. estimate, 6.4 months

Height Gain \ Weight:	50	60	70	80	90	100	110	120	130
5.0			11-2	10-11	10-9	10-6	10-3	10-1	9-10
4.5			11-7	11-4	11-1	10-11	10-8	10-5	10-2
4.0		12-2	11-11	11-8	11-6	11-3	11-0	10-10	10-7
3.5		12-6	12-4	12-1	11-10	11-8	11-5	11-2	10-11
3.0	13-2	12-11	12-8	12-6	12-3	12-0	11-9	11-7	11-4
2.5	13-6	13-4	13-1	12-10	12-7	12-5	12-2	11-11	11-9
2.0	13-11	13-8	13-5	13-3	13-0	12-9	12-7	12-4	
1.5	14-3	14-1	13-10	13-7	13-5				
1.0	14-8	14-5	14-2	14-0					

Age 12 (11.5 to 12.49); R, .57; P.E. estimate, 6.7 months

Height Gain \ Weight:	50	60	70	80	90	100	110	120	130	140
4.5	13-3	13-0	12-9	12-6	12-2	11-11	11-8	11-5	11-2	10-11
4.0	13-5	13-2	12-11	12-8	12-5	12-2	11-11	11-7	11-4	11-1
3.5	13-8	13-5	13-2	12-10	12-7	12-4	12-1	11-10	11-7	11-3
3.0	13-10	13-7	13-4	13-1	12-10	12-7	12-3	12-0	11-9	11-6
2.5	14-1	13-10	13-6	13-3	13-0	12-9	12-6	12-3	11-11	11-8
2.0	14-3	14-0	13-9	13-6	13-3	12-11	12-8	12-5	12-2	11-11
1.5	14-6	14-2	13-11	13-8	13-5	13-2	12-11	12-8	12-4	12-1
1.0	14-8	14-5	14-2	13-11	13-7	13-4	13-1	12-10	12-7	12-4
.5	14-11	14-7	14-4	14-1	13-10	13-7	13-3	13-0	12-9	12-6

Age 13 (12.5 to 13.49); R, .57; P.E. estimate 6.8 months

Height Gain \ Weight:	50	60	70	80	90	100	110	120	130	140	150
4.5	14-10	14-7	14-4	14-1	13-11	13-8					
4.0	14-8	14-5	14-2	13-11	13-9	13-6	13-3	13-1			
3.5	14-6	14-3	14-0	13-10	13-7	13-4	13-1	12-11	12-8	12-5	12-2
3.0	14-4	14-1	13-10	13-8	13-5	13-2	12-11	12-9	12-6	12-3	12-0
2.5	14-2	13-11	13-8	13-6	13-3	13-0	12-9	12-7	12-4	12-1	11-10
2.0	14-0	13-9	13-6	13-4	13-1	12-10	12-8	12-5	12-2	11-11	11-8
1.5		13-7	13-5	13-2	12-11	12-8	12-6	12-3	12-0	11-9	11-7
1.0			13-3	13-0	12-9	12-6	12-4	12-1	11-10	11-7	11-5
.5				12-10	12-7	12-4	12-2	11-11	11-8	11-5	11-3

Age 14 (13.5 to 14.49); R, .72; P.E. estimate, 5.7 months

Height Gain \ Weight:	60	70	80	90	100	110	120	130	140	150	160
4.0	15-4	15-3	15-2	15-2	15-1	15-0	14-11				
3.5	15-0	14-11	14-10	14-9	14-8	14-7	14-6	14-5			
3.0	14-7	14-6	14-5	14-4	14-3	14-2	14-1	14-0	13-11		
2.5	14-2	14-1	14-0	13-11	13-11	13-10	13-9	13-8	13-7	13-6	13-5
2.0	13-9	13-9	13-8	13-7	13-6	13-5	13-4	13-3	13-2	13-1	13-0
1.5	13-5	13-4	13-3	13-2	13-1	13-0	12-11	12-10	12-9	12-8	12-8
1.0			12-10	12-9	12-8	12-8	12-7	12-6	12-5	12-4	12-3
.5				12-5	12-4	12-3	12-2	12-1	12-0	11-11	11-10
0						11-10	11-9	11-8	11-7	11-6	11-5

considerable range of error is involved in these predictions. Provision of such instruction for each girl at her predicted menarcheal age will anticipate the menarche in only 50 per cent of the cases. Provision of such instruction for each girl at an age obtained by subtracting the probable error of estimate from predicted menarcheal age will anticipate the menarche in 75 per cent of the cases. Provision of such instruction for each girl at an age obtained by subtracting twice the probable error of estimate from predicted menarcheal age will anticipate the menarche in 91 per cent of the cases.

Table II, involving weight and annual gains in height, provides much superior predictions. Here the correlations range from .51 to .72 (against .37 to .53 in Table I) and the probable errors of estimate range from 6.4 to 6.8 months (against 6.9 to 7.5 in Table I). These more accurate predictions warrant special efforts on the part of school systems to collect the necessary cumulative data. It is recommended that measurements be taken twice a year at intervals of six months so that, after this regimen is established, two sets of annual gains in height will be available each year. Since at age 11 a difference of only half an inch in the annual stature increments makes a difference of four and a half months in the predicted menarcheal age, it is imperative that measurements of height be taken with considerable care. Table II is read in much the same manner as Table I. Weight of 100 pounds at the tenth birthday and a gain of four inches in stature between the ninth and tenth birthdays indicate a menarcheal age of 10–10; the same weight and annual gain at the eleventh birthday indicate a menarcheal age of 11–3; the same weight and annual gain at age ten and a half indicate a menarcheal age of 11–0 or 11–1 (the average of predictions at 10 and 11). As in Table I, provision for instruction at an age obtained by subtracting twice the probable error of estimate from predicted menarcheal age will anticipate the actual advent of the menarche in 91 per cent of the cases. Certain technical details and the basic statistical data for these predictions have been published in a recent monograph.[11]

The foregoing tables are not recommended for general adoption in the public schools, at least for the present, but rather for experimental trial under favorable conditions. These require a community which welcomes educational experimentation and which is more open-minded than the average in its attitudes toward problems of sex education, an administrative setup that is sympathetic and that will cooperate in the collection of the necessary physical measurements, and a person immediately responsible for the program who has considerably above average insight into the mental hygiene aspects of the problem.

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11. Shuttleworth, Frank K., "The Physical and Mental Growth of Girls and Boys Age Six to Nineteen," *Monog. Soc. Res. Child Develop.*, Vol. IV, No. 3. (Washington, D. C.: National Research Council, 1939) 289–291. (In Table 110 the last two regression equations for height and weight should carry plus instead of minus signs for the height variable.)

The Effect of Football and Basketball On Vision

By Lyle Tussing
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HAND-EYE coordination is the basis of many athletic sports. However, the matter of vision in athletic contests is a subject upon which relatively little data has been obtained. The effect of football or basketball playing on the participant's vision is a matter worthy of consideration. The present study purports to present some objective evidence in this field and hopes to stimulate further investigation of vision in athletics.

PROCEDURE

The subjects used in this experiment were men who were playing freshman football and men who were on the varsity basketball squad. The subjects were tested before going out for practice and after they had obtained a work-out. In each case the subjects were asked to record their feeling on a 7-point continuum which ranged from "very tired" (as tired as you have ever been) at the lower end to "very fresh" (as fresh as you have ever been) at the other, with 4 as a neutral point. This feeling was recorded both before and after the fatigue situation. The average for the football players was 5.1 before and 3.6 after the practice—a drop of about 1.5 points closer to the extreme fatigue end of the scale. The average for the basketball players was 4.9 before and 2.8 after—a drop of 2.1 points.

The tests for the most part were performed with the Keystone telebinocular.* In the test for acuity, card DB2 for the left eye and DB3 for the right eye were used. For testing lateral imbalance, card DB9A was used. In the fusion tests the PF series were used. The adduction-abduction test was made by using cards "Read 4R301 and 302." The operator had the two cards placed at "read"; the cards were adjusted until in focus for the individual. The right card was then pulled out. The place at which the subject reported a blur or break was recorded. The card was then placed at the original position and pushed in until the blur or break occurred. The *in* reading was recorded as adduction; the *out* reading as abduction. This test was run just once. The test for stereopsis was made with card DB6 and the SM1 series at far point. (Any one recognition per card on the SM1 series was considered as correct.) The number of blinks made in one minute while the subject

*A special slide holder was used which placed the card one inch farther from lens than indicated by readings on slide.

looked at an open cube illusion was recorded. The illusion of a 4 inch open cube at 20 feet distance was used as a criteria for shifts in attention. The number of fluctuations per minute observed by the subject was recorded.

Table I shows the results obtained on the various tests from football players. Table II shows the results obtained from basketball players. To determine if there was a significant change, the statistic t was obtained using Fisher's technique for small samples.[1] The t statistic indicates the percentage of time the mean of a second sample could be obtained by a chance selection.

CONCLUSION

It can be seen from the tables that there is a tendency for acuity of the left eye to be less after practice in football. The possibility of this happening by chance is about one in five. The acuity of the left eye

TABLE I

EYE TESTS FOR FOOTBALL PLAYERS

Function Measured	*N.*	Av. *Before* Fatigue	Av. *After* Fatigue	Number Having *More*	*Less*	*Same*
Acuity, Right Eye	15	83%	82%	2	4	9
Acuity, Left Eye	15	82%	76%	3	7	5
Lateral Imbalance, Far	15	2.13 E	1.73 E	6 (in)	3 (out)	6
Lateral Imbalance, Near	15	8.4 X	7.1 X	5 (in)	5 (out)	5
Fusion	15	43%	42%	3	4	8
Abduction	15	11.4 mm.	6.4 mm.	6	8	11
Adduction	15	16.6 mm.	13.6 mm.	2	11	2
Stereopsis*	15	6.93	7.40	7	2	6
Blinks per minute	14	5.3	6.8	8	4	2
Cube Fluctuations	15	25.6	26.6	9	5	1
Fatigue Rating	15	5.1	3.6	10	2	3

E—esophoria (tendency to turn in)
X—exophoria (tendency to turn out)
* Depth perception

in basketball tends to become better after practice. The possibility of this happening by chance is about one in five using the Fisher technique. Although such results could happen by chance, it appears that in basketball there will be a greater opportunity to use the eyes and because of the exercise given them, the acuity is improved, especially in the eye which is not dominant in most individuals. Fusion seems to drop to some extent in basketball. The chance that this would happen in the selection of a sample is about one out of seven. The only other result that comes close to being statistically significant is the adduction for football players the results of which could happen by chance in the order of one to ten.

[1] Fisher, "Statistical Methods for Research Workers," from *Statistical Analysis in Educational Research*, by E. F. Lindquist, Private printing, pp. 36.

The tests indicate that there are wide individual differences in vision. They also indicate that routine practice causes individual differences, some players showing marked impairment of vision and some an improvement with practice. These individual tendencies might prove to be valuable information for a coach. There were also group tendencies in different eye measurements after practice. However, it appears on the average, that the strain of basketball and football practice per

TABLE II

EYE TESTS FOR BASKETBALL PLAYERS

Function Measured	*N.*	Av. *Before* Fatigue	Av. *After* Fatigue	Number Having *More*	*Less*	*Same*
Acuity, Right Eye	21	72.9%	73.3%	8	3	10
Acuity, Left Eye	21	75.7%	82.1%	7	2	12
Lateral Imbalance, Far	21	2.9 E	3.0 E	4 (in)	7 (out)	10
Lateral Imbalance, Near	21	3.7 X	3.0 X	11 (in)	4 (out)	6
Fusion	21	41.9%	36.2%	2	8	11
Abduction	20	4.8 mm.	4.0 mm.	6	8	6
Adduction	20	3.8 mm.	3.8 mm.	6	7	7
Stereopsis*	21	6.9	7.2	4	5	12
Blinks per minute	20	4.5	4.1	8	9	3
Cube Fluctuations	20	19.3	19.3	8	12	0
Fatigue Rating	21	4.9	2.8	18	2	1

E—esophoria (tendency to turn in)
X—exophoria (tendency to turn out)
* Depth perception

se does not cause an impairment of the player's vision from the practical point of view. The findings also indicate that vision of the "100 per cent" type is not needed for basketball or football if this sample can be classified as representative.

The present research indicates that further investigation might be carried on in different sports; also that other tests of vision such as speed of vision with a tachistoscope, area of the field of vision, and hand-eye coordination could be administered before and after practice. Valuable information might also be obtained on the rate of recovery. The investigation of individuals who have consistent loss or improvement in vision should also prove interesting.

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The Sanction of the Health Examination

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Part I. By State Departments of Education

GREAT strides have been taken since the medical inspection of school children first appeared under the aegis of the public tax-supported school. The earliest medical inspections were provided largely for the control of communicable diseases, whereas progressive school systems now extend the medical and dental services to include a complete health inventory by the physician, nurse, and dentist with an effective program of follow-up for the correction of the remediable defects.

School medical supervision, now undertaken by many nations, is another phase of the recent conservation movement. In the United States some attention has been directed recently to the stoppage of waste, both in our natural and in our human resources. The great problem of national conservation, however, is not so much in conserving the soils or mines or forests or water-power, important as these may be, but in the conservation of our national vitality.[1]

Many school systems provide the health examination of the child for the same reason that they provide the psychological examination so that the program of the school may be more intelligently adapted to the individual needs and capacities of the child. Furthermore, the health examination when it is properly administered can be a most valuable educational experience for school children. The assurance that one's health is normal or the knowledge that certain defects are present which may be remedied are real outcomes of the examination. In the more enlightened communities the public schools are assuming the responsibility of providing the services of dentists, physiotherapists, special teachers of physical education, and others for the correction of those remediable defects revealed in the health examination.

In some secondary schools there is one group which has enjoyed medical services more extensively than some others. This is the group of boys which represents the school in the field of interscholastic athletics. The present status of the sanction of the health examination by the state high school athletic association or other governing body is reported in Part II of this study. There is an increasing tendency to

[1] Ellwood P. Cubberley. *Public School Administration*, p. 622.

extend these services to all of the children of the school. In each state the department of education is in an especially strategic position to furnish the leadership and guidance to the local community in the attainment of this desirable goal. In those states where a state director of health and physical education is employed in the state department of education even greater opportunities are afforded. In order to determine the extent to which the various state departments of education are encouraging the health examination of school children a study of the sanctions provided by the various states has been made.[2] The data were obtained by means of personal correspondence and interviews with officials of the state departments of education, questionnaires from officials of the state departments of education, and the statutes and other regulations of the various states pertaining to the health services in the public schools. A summary of the findings is reported in Table I.

It is impossible to evaluate the health examinations as they are conducted in the various states or in the various communities within the several states where the examinations are required; there is, no doubt, a great variation both in the thoroughness of the examination as well as in the effectiveness of the follow-up program for correction of remediable defects.

For the purpose of reporting the present status of the sanction of the health examination by the various state departments of education, the states are divided into eight geographical divisions and the requirements and recommendations are given below.

DIVISION I. THE PACIFIC STATES

Washington: Recommended but not required. The program of school health service is now developing in this state. Much is already being done in many of the more enlightened schools.

Oregon: Recommended but not required. Many local school districts of this state do provide for complete health examinations for all of the pupils in the secondary schools.

California: Recommended but not required. The responsibility for this phase of school health service is placed with local boards of education. Many schools of this state have excellent programs of health examination, while others have made scarcely any attack on the problem.

DIVISION II. THE PLATEAU STATES

Montana: Not required. The state department of education reported that there were no regulations in regard to this phase of school health service.

Idaho: Recommended but not required. The state department of education reported that this phase of school health service was being given increased attention from year to year. Many schools provide for a complete health examination of each pupil.

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[2] James E. Hatfield. *The Health Examination in the Public Senior High Schools of West Virginia*, unpublished thesis, West Virginia University Library.

Wyoming: Required. All of the pupils are given a complete health examination annually.

Nevada: Recommended but not required. Many schools of the state are doing fine work in this phase of school health.

Utah: Recommended but not required. This state, at the present time, is attempting to work out a compulsory and uniform health examination. All pupils in the seventh and tenth grades are to be examined annually.

Colorado: Recommended but not required. Many schools administer thorough health examinations to all pupils. Testing for tuberculosis is conducted quite extensively.

Arizona: Recommended but not required. Health examinations in this state are conducted at the option of local boards of education. Excellent work is being done in several places.

New Mexico: Recommended but not required. A joint committee of the state department of education and the state department of health is at the present time working on this phase of school health service.

DIVISION III. THE NORTH CENTRAL STATES

North Dakota: Recommended but not required. The Fargo city schools conduct health examinations extensively. At the present time, the state is establishing health nurses throughout the state, under the direction of the state department of public health.

Minnesota: Required. Complete and thorough health examinations are given to all pupils. A permanent health record card is kept for all pupils of school age.

Wisconsin: Recommended but not required. Many secondary schools conduct health examinations extensively.

Michigan: Recommended but not required. There is no uniform health examination or follow-up practices in this state. However, in most of the schools excellent work of this type is being done.

Ohio: Required. A complete health examination is administered to all the pupils at least once during the four-year course. All follow-up work is conducted by public school agencies.

Indiana: Recommended but not required. Although this phase of school health service is not required by the state, many schools do provide rather thorough health examinations for all of the pupils.

Illinois: Not required. There are no special regulations in regard to this phase of school health service.

Iowa: Not required. There are no special regulations in regard to this phase of school health service.

Missouri: Not required. Personal correspondence received from this state indicated that the health examination was not a state requirement. However, the school code stated that medical examination of pupils was required.

Nebraska: Required. Although a general health examination is given to all pupils at the present time, future plans in the state call for a more comprehensive program of school health service.

Kansas: Recommended but not required. Many of the local districts do require the health examination annually.

TABLE I

REQUIREMENTS AND RECOMMENDATIONS OF STATE DEPARTMENTS OF EDUCATION AFFECTING THE SCHOOL HEALTH EXAMINATIONS IN THE UNITED STATES

Geographic Division	State	Health Examination is a state Requirement	Health Examination is Recommended	No Regulations are Specified
PACIFIC				
	Washington		X	
	Oregon		X	
	California		X†	
PLATEAU				
	Montana			X
	Idaho		X	
	Wyoming	X		
	Nevada		X	
	Utah		X†	
	Colorado		X	
	Arizona		X	
	New Mexico		X	
NORTH CENTRAL				
	North Dakota		X	
	Minnesota	X†		
	Wisconsin		X	
	Michigan		X	
	Ohio	X†		
	Indiana		X†	
	Illinois			X†
	Iowa			X
	Missouri	X†		
	Nebraska	X†		
	Kansas		X	
	South Dakota*			X
SOUTH CENTRAL				
	Oklahoma*			X
	Texas		X	
	Arkansas		X†	
	Mississippi			X
	Louisiana		X†	
	Alabama	X†		
	Tennessee		X	
	Kentucky		X	
MIDDLE ATLANTIC				
	Pennsylvania	X†		
	New York	X†		
	New Jersey	X†		

* The health examination is recommended by the state department of health.

† A director of health and physical education is employed by this state department of education. James E. Rogers *News Letter of the National Physical Education Service of the National Recreation Association.* No. 125, December 1, 1939, p. 17.

Geographic Division	State	Health Examination is a state Requirement	Health Examination is Recommended	No Regulations are Specified
SOUTH ATLANTIC				
	Delaware	X†		
	Maryland		X†	
	West Virginia		X	
	Virginia	X†		
	North Carolina			X†
	South Carolina	X		
	Georgia			X†
	Florida		X†	
NEW ENGLAND				
	Connecticut	X†		
	Rhode Island	X		
	Massachusetts	X†		
	New Hampshire	X		
	Vermont		X†	
	Maine		X†	
DISTRICT OF COLUMBIA		X		
TOTAL		17	24	8

South Dakota: Not required. There are no special regulations in regard to this phase of school health service.

DIVISION IV. THE SOUTH CENTRAL STATES

Oklahoma: Not required. There is no law relating to the supervision of health and physical education.

Texas: Recommended but not required. The responsibility for this phase of school health service is placed with the local boards of education. In many places, excellent programs exist.

Arkansas: Recommended but not required. Many local school units carry out good programs of health examination work. The city schools of Little Rock conduct an excellent program of health examinations and follow-up work.

Mississippi: Not required. There are no special regulations in regard to this phase of school health service.

Louisiana: Recommended but not required. A general examination is given to all pupils in most of the secondary schools.

Alabama: Required. An excellent system of health examination and follow-up work exists in this state. The health record card from this state indicated that a rather complete health examination is given.

Tennessee: Recommended but not required. Many schools in this state conduct good programs of health service.

Kentucky: Recommended but not required. Local boards of education make special requirements in regard to this phase of school health service.

DIVISION V. THE SOUTH ATLANTIC STATES

Delaware: Required. A complete health examination is administered to all secondary school pupils annually. This state has an excellent cumulative health record card.

Maryland: Recommended but not required. Many of the more progressive schools of this state provide for a complete health examination of all pupils.

West Virginia: Recommended but not required. Only a few districts provide the health examination in this state.

Virginia: Required. The classroom teachers of this state are trained to make general health inspections. A physician makes a thorough examination of selected pupils.

North Carolina: Not required. Few schools, except city systems, do anything in regard to this phase of school health service.

South Carolina: Required. A general system of health examinations exists in this state.

Georgia: Not required. There are no special regulations in regard to this phase of school health service.

Florida: Recommended but not required. The schools in this state vary in their health examination practices from excellent to nothing at all.

DIVISION VI. THE MIDDLE ATLANTIC STATES

Pennsylvania: Required. A complete health examination is given at least once each year by the school physician and nurse to all pupils.

New York: Required. A complete health examination is given at least once each year by school physician and nurse to all pupils. Special examinations are arranged for selected pupils.

New Jersey: Required. A complete health examination is given at least once each year by the school physician and nurse to all pupils.

DIVISION VII. THE NEW ENGLAND STATES

Connecticut: Required. The majority of schools provide thorough health examinations of all pupils, while other schools make a quick inspection of the heart and lungs of selected groups.

Rhode Island: Required. Complete examinations of pupils is required from kindergarten through grade twelve. This state has an excellent program.

Massachusetts: Required. A complete health examination is given annually to all pupils with special attention to selected groups.

New Hampshire: Required. A complete examination is administered annually to all pupils. A health record for each pupil is kept throughout school life. An excellent follow-up program is carried out in this state.

Vermont: Recommended but not required. Testing for vision and hearing is a state law.

Maine: Recommended but not required. At the present time, excellent programs of health examination and follow-up work exist in many schools, while others have no program at all.

DIVISION VIII. THE DISTRICT OF COLUMBIA

The District of Columbia: Required. A thorough health examination is administered to all pupils entering this school system for the first time. This

is required before admission. As the pupils are promoted from year to year, no further health examination is given, unless there seems to be some physical defect which requires it. Special attention is given to athletic squads.

SUMMARY

From the data presented here it is clear that the state departments of education vary greatly in their sanction of the health examination. Within the several geographic divisions of the United States (with the exception of the Middle Atlantic States) there is little uniformity in the requirements. Twenty-four states recommend that a health examination be given to high school pupils while eight states have neither requirement nor recommendation.

It is encouraging to see, however, that in sixteen states and in the District of Columbia a complete health examination of all pupils is required by the departments of education. In these states there is, no doubt, considerable variation in the thoroughness of the examination and in the effectiveness of the follow-up program.

It is also clear that the influence of the state director of health and physical education has considerable effect on the provision of the health examination. In only three states where the health examination is neither required nor recommended is a state director employed while only two states have made the examination a requirement without enjoying the services of a state director.

The state department of education in each of the states is in a strategic position to furnish the leadership and guidance to the local school systems so that every school child may enjoy the benefits of the periodic health examination as well as an effective follow-up program for the correction of the remediable defects revealed in the health examination.

Part II. By State High School Athletic Associations[3]

Within recent years there has been a tendency to reemphasize the program of health conservation and health building in the public schools. According to a recent report of the Educational Policies Commission, "The provision of medical and dental examinations at regular intervals during the school career of each child constitutes a definite responsibility of school authorities. . . . The board of education is obligated to provide the services of physicians for the same reason that it provides the services of psychologists and, at times, psychiatrists, for making mental health inventories, namely, to determine health status, facilitate removal of handicaps to learning, and find out whether some adaptation of the school program may be necessary (as, for example,

[3] Each state does not have a high school athletic association. In some states the interscholastic athletic program is controlled by the "high school activities association," "literary and athletic league," and the like.

the omission of some forms of physical education or provision of lip reading or sight-saving classes)."[4]

The desirability of the health examination as a requisite to participation in vigorous interscholastic athletics is generally recognized. There remains, however, the administrative problem of the provision of such examination. The state high school athletic association or other official organization charged with the administration of the interscholastic athletic program is in a strategic position to provide the leadership needed to assure each boy who engages in athletics every reasonable safeguard for his health. In those states where such an examination is required by an official organization the associations are in a position to enforce the regulation which provides a health inventory. According to Williams and Brownell the chief functions of the state athletic associations are as follows: "(1) Preserve the health of contestants by requiring suitable health supervision; (2) Classify schools into equitable groups; (3) Determine rules of eligibility; (4) Promote standards of conduct (sportsmanship); (5) Establish standards of giving awards; (6) Control the length of schedules and practice periods; (7) Provide standards for athletic coaches and officials; and (8) Settle disputes between local groups." [5]

In order to determine the extent to which various states are providing the health examination as a part of the conservation of the health of athletes a study of the sanctions and regulations provided in the various states has been made.[6] The data were obtained by means of personal correspondence and interviews with school and association officials, questionnaires from association officials, and printed documents of the various high school athletic associations.[7] A summary of the findings is reported in Table II.

Some state high school athletic associations place the health examination of all athletes as a prerequisite to membership in the association while other associations merely recommend that a health examination be given. Seven of the states have no such requirement for membership and do not make any recommendation for a health examination. It is impossible to evaluate the thoroughness or efficacy of the health examination in those states where it is required; there is, no doubt, a great variation in these respects among the various states.

For purposes of reporting the present status of the sanction of the health examination by the various state high school athletic associations the states are divided into eight geographical divisions and the requirements and recommendations are given below.

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[4] Educational Policies Commission. *Social Services and the Schools*, pp. 74–75.

[5] J. F. Williams and C. L. Brownell, *The Administration of Health and Physical Education*, p. 442.

[6] James E. Hatfield, *op. cit.*

[7] Delaware does not have a state high school athletic association and the District of Columbia is reported as a separate unit.

DIVISION I. THE PACIFIC STATES

Washington: Required. "No student shall be eligible to represent his school in high school athletics unless there is on file with the superintendent or principal a physician's statement for the current year certifying that the student has passed an adequate physical examination, and that in the opinion of the examining physician he is fully able to participate in high school athletics." (Constitution and By-Laws)

Oregon: Recommended. All athletes, however, are required to submit to a physical examination before participating in any basketball tournament, district, or state track meet.

California: Required. Regulations of the health examination for athletes are specific.

DIVISION II. THE PLATEAU STATES

Montana: Recommended. All athletes, however, are required to submit to a physical examination before participating in any basketball tournament, district, or state track meet.

Idaho: Recommended. The Association hopes to make this a mandatory requirement soon.

Wyoming: Required. "It is a mandatory requirement that each athlete present a physician's certificate stating that the physician has personally examined the athlete and that he may safely engage in competitive sports." (Constitution and By-Laws)

Nevada: Recommended. Many member schools of this Interscholastic League do make this a requirement.

Utah: Required. "No student shall be eligible for competition in any athletic activity who is not able to pass a physical examination given by an M.D. That such an examination has been given and successfully passed by the student shall be certified to on the eligibility application form." (Constitution and By-Laws)

Colorado: Recommended. This athletic conference recommends that any athlete participating in interschool contests should submit to a thorough physical examination on or before the opening of the current season.

Arizona: Neither required nor recommended. There were no regulations of the health examination given.

New Mexico: Recommended. There were no regulations for the health examination given.

DIVISION III. THE NORTH CENTRAL STATES

North Dakota: Recommended. This league recommends that all school boy athletes be examined by a physician before participating in interscholastic contests.

Minnesota: Required. "The Master Eligibility List shall contain in addition to a declaration of eligibility, a statement showing that each student has passed a physical examination and that a certificate is on file in the superintendent's or principal's office." (Constitution and By-Laws)

Wisconsin: Required. "A boy will not be eligible for certification until he has filed with the principal an Examination and Permit Card containing a physician's certification of physical fitness and his parent's permit to participate in athletics." (Constitution and By-Laws)

TABLE II

REQUIREMENTS AND RECOMMENDATIONS OF HIGH SCHOOL ATHLETIC ASSOCIATIONS AFFECTING THE SCHOOL HEALTH EXAMINATIONS IN THE UNITED STATES

Geographic Division	State	Health Examination is a Requirement	Health Examination is Recommended	No Regulations are Specified
PACIFIC				
	Washington	X		
	Oregon		X	
	California	X		
PLATEAU				
	Montana		X	
	Idaho		X	
	Wyoming	X		
	Nevada		X	
	Utah	X		
	Colorado		X	
	Arizona			X
	New Mexico		X	
NORTH CENTRAL				
	North Dakota		X	
	Minnesota	X		
	Wisconsin	X		
	Michigan	X		
	Ohio	X		
	Indiana	X		
	Illinois		X	
	Iowa	X		
	Missouri	X		
	Nebraska	X		
	Kansas	X		
	South Dakota	X		
SOUTH CENTRAL				
	Oklahoma	X		
	Texas			X
	Arkansas			X
	Mississippi			X
	Louisiana	X		
	Alabama	X		
	Tennessee			X
	Kentucky		X	
MIDDLE ATLANTIC				
	Pennsylvania	X		
	New York	X		
	New Jersey*		X	

* The health examination of all pupils is required by the state department of education.

Geographic Division	State	Health Examination is a Requirement	Health Examination is Recommended	No Regulations are Specified
SOUTH ATLANTIC				
	Delaware*			X
	Maryland		X	
	West Virginia		X	
	Virginia	X		
	North Carolina	X		
	South Carolina	X		
	Georgia	X		
	Florida	X		
NEW ENGLAND				
	Connecticut	X		
	Rhode Island*		X	
	Massachusetts*		X	
	New Hampshire*		X	
	Vermont	X		
	Maine			X
DISTRICT OF COLUMBIA		X		
TOTAL		27	15	7

Michigan: Required. "No student shall be eligible to represent his school for whom there is not on file with the superintendent or principal, a physician's statement for the current school year certifying that the pupil has passed an adequate physical examination and that in the opinion of the examining physician he is fully able to compete in interscholastic athletic contests." (Constitution and By-Laws)

Ohio: Required. "The administrative head of the school shall have each pupil who is trying for a place on the team present a physician's certificate at least once each year to the effect that he or she is physically fit for athletic competition." (Constitution and By-Laws)

Indiana: Required. "A student who practices for any interscholastic football, basketball, track, boxing, wrestling, or swimming contest, shall have on file in the Principal's office a certificate of physical fitness and a certificate giving the written consent of the parents for such athletic participation as is specified therein. The physical examination shall be made prior to the first practice during the season of each of the six sports by a regularly licensed physician. Previous to the first practice, the Principal shall certify to the I.H.S.A.A. that the certificates required herein are on file in his office." (Constitution and By-Laws)

Illinois: Recommended. There were no regulations of the health examination specified.

Iowa: Required. "Every year each student shall present to his superintendent upon a blank provided for that purpose by the Board of Control a Physician's certificate to the effect that he has examined the student and that he may safely engage in athletic competition." (Constitution and By-Laws)

Missouri: Required. "A physician's certificate shall be required of each student, showing that he is physically able to participate in the athletic contests of his school." (Constitution and By-Laws)

Nebraska: Required. "Each team member who expects to participate in athletic contests shall present to the superintendent or principal once each year before actual participation in any interschool sport, a physician's certificate on a form prescribed by the N.H.S.A.A. that he is physically fit for athletic participation." (Constitution and By-Laws)

Kansas: Required. "No high school student shall be eligible for high school athletics until there is on file with the superintendent or principal a statement signed by a practicing physician certifying that he has passed an adequate physical examination since September 1st of the current year, and that in the opinion of the examining physician he is physically fit to participate in high school athletics." (Constitution and By-Laws)

South Dakota: Required. "Each school year all candidates for membership on any high school athletic team shall have their parents' consent to compete and shall be certified by a duly-licensed doctor of medicine or a duly-licensed four-year trained osteopath, upon official blanks provided for these purposes, previous to competition on any high school athletic team. A column shall be provided on the official eligibility blank for the date of such examination, which date shall be required when eligibility lists are submitted by the school officials." (Constitution and By-Laws)

DIVISION IV. THE SOUTH CENTRAL STATES

Oklahoma: Required. "All students shall have on file with the principal a certificate showing that they have been examined by a physician, and that they are physically fit to participate in athletic contests." (Constitution and By-Laws)

Texas: Neither required nor recommended. There were no regulations of the health examination specified.

Arkansas: Neither required nor recommended. There were no regulations of the health examination specified.

Mississippi: Neither required nor recommended. There were no regulations of the health examination specified.

Louisiana: Required. "Immediately before any athletic contest, the team physician, or some other physician, must be present and examine the contestants for any organic defects; and no boy shall be permitted to participate unless he has been approved by the physician. A team physician shall be present during all interschool contests." (Constitution and By-Laws)

Alabama: Required. "No pupil shall be eligible to represent his school in interscholastic athletics unless there is on file in the superintendent's or principal's office a physician's statement for the current year certifying that the pupil has passed an adequate physical examination and that in the opinion of the examining physician he is fully able to participate in high school athletics." (Constitution and By-Laws)

Tennessee: Neither required nor recommended. There were no regulations of the health examination specified.

Kentucky: Recommended. There were no regulations of the health examination specified.

DIVISION V. THE SOUTH ATLANTIC STATES

Delaware: (No State High School Athletic Association). The state department, however, has a mandatory requirement to the effect that all pupils, athletes included, submit to a complete health examination.

Maryland: Recommended. There were no regulations of the health examination specified.

West Virginia: Recommended. "To protect the best interests of the individual student, the school he represents, and the cause of athletics in general, it is earnestly recommended that each school have its athletes examined by a competent physician before the first game of each season." (Constitution and By-Laws)

Virginia: Required. "He shall present before he becomes a candidate for participation in the first competitive sport sponsored by the League a physician's certificate on a form prescribed by his State Association that he is physically fit for athletic competition." (Constitution and By-Laws)

North Carolina: Required. A physician's statement to the effect that each student competing in interscholastic sports for the current year is physically fit must be on file with the principal.

South Carolina: Required. This high school league requires that each boy participating in interschool athletics submit to a complete health examination before practice begins for the current season. A physician's certificate must be filed in the principal's office.

Georgia: Required. "All pupils interested in participating in interscholastic athletic contests must submit to a complete health examination preceding the opening of each current season. A doctor's certificate must be on file with the principal or superintendent." (Constitution and By-Laws)

Florida: Required. "A student must secure a physician's certificate to the effect that he is physically fit for any athletic participation. This certificate must be on file in the principal's office." (Constitution and By-Laws)

DIVISION VI. THE MIDDLE ATLANTIC STATES

Pennsylvania: Required. "No pupil shall be eligible to represent his high school in any athletic contest unless he has been examined each sport season by a school physician or other regular physician, and his condition pronounced satisfactory before he commences to train or practice in the sport in which he intends to participate. A certificate to this effect shall be on file with the principal at the time said principal certifies to the eligibility of his players.

"In addition to the examinations of a player before each sport season, it is recommended that players be given thorough physical examinations by a physician, periodically, throughout the actual playing season." (Constitution and By-Laws)

New York: Required. "A complete health examination is required of all participants in interscholastic sports. A physician's certificate stating that the pupil is physically fit to compete in any athletic contest must be on file in the principal's or superintendent's office." (Constitution and By-Laws)

New Jersey: Recommended. This state, however, has a mandatory requirement to the effect that all pupils, athletes included, must submit to a thorough health examination.

DIVISION VII. THE NEW ENGLAND STATES

Connecticut: Required. "The student shall present at least once each year a physician's certificate on a form prescribed by his State Association that he is physically fit for athletic competition." (Constitution and By-Laws)

Rhode Island: Recommended. The health examination is a mandatory state requirement for all pupils in Rhode Island.

Massachusetts: Recommended. This state has a mandatory requirement to the effect that all pupils, athletes included, must submit to a complete health examination. The physician's certificate is placed on file in the principal's office.

New Hampshire: Recommended. This state has a mandatory requirement to the effect that all pupils, athletes included, must submit to a complete health examination. The physician's certificate is placed on file in the principal's office.

Vermont: Required. A physician's certificate for each athlete in this state, stating that he is physically fit to participate in interscholastic contests, must be on file in the principal's office.

Maine: Neither required nor recommended. There were no regulations of the health examination specified.

DIVISION VIII. THE DISTRICT OF COLUMBIA

The District of Columbia: Required. "A student who participates in any interschool athletic contest shall have on file in the principal's office a certificate of physical fitness for such athletic participation as is specified therein. The Head of the Department of Health and Physical Education in each division shall prepare such certificates and distribute them to the principals. The medical examination shall be made during the season of each sport and before the first interschool contest by the school physician (or by a physician approved by the school physician). Previous to the participation the principal shall certify to the Head of the Department of Health and Physical Education in his division, that the certificate required in this proposal is on file in his office." (Constitution and By-Laws)

SUMMARY

From the data presented here it is clear that the leaders in a majority of the state high school athletic associations believe that the health examination of athletes is of vital importance. Fifteen of the state associations do not, however, believe that it is of sufficient importance to require it before pupils are permitted to engage in the interscholastic athletic program. It is of interest to note that seven of the associations which neither recommend nor require the health examination are in the south central section of the United States.

When all of the state high school athletic associations establish the health examination of all participants in the interscholastic athletic program as a prerequisite to membership in the association a distinct step forward will have been taken toward the first goal of the association, viz., the conservation of the health of the athlete.

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Rhythmics in Music and Dance

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RHYTHM may be defined as a harmonious recurrence of events. In music these may be simple or complex auditory groupings. Their flow may be an evanescent repetition of pulsating beats, voiced regularly or irregularly through the use of accent, or the harmonious iteration of theme, cadence, and phrase combined in an inexhaustible variety of ways to express all manner of moods or abstract concepts. Dance movements may be swinging, sustained, percussive, suspended, or relaxed. The intensity with which they are executed in a variety of directions at different levels in space gives to them a capacity for organization into an art form imparting feeling states and ideas similar to those expressed in music. Because the vocabulary of physical movements is limited in comparison with the number of combinations of sound perceived by the human ear, the rhythms of dance are in general less complex than those of music.

The fundamental components of rhythm are four in number. These are (1) sequences of events in time which (2) are repeated and so related as to (3) duration and (4) intensity as to make recognizable patterns. These basic components occur simultaneously in part or in whole in all rhythmic events. The object of this paper is to discuss them individually by simple analogy and application, and then to analyze their particular manifestations in the arts of music and dance.

Rhythm is Perceived through the Sense Organs.—Many natural phenomena are rhythmic. Their manifestations unfold in a never-ending flow of patterns ranging from the mightiest cosmic movements to the minutest dance of electrons around their protons. Rhythm may exist in the Universe, but for all practical purposes its laws of organization rest hidden and unknown unless we perceive its fundamental components through the visual, auditory, or kinesthetic senses. If we remain unaware of the pulse beats in time, the length or intensity of sounds, and the repetition of similarly built acoustical effects, we cannot grasp the whole form of a musical composition and the idea which produced it escapes us. So also in dance, the human body moving in space gives rise to no completely cogent idea unless the fundamental components of its rhythmic organization impinge upon the sensory receptors with an adequate series of orderly and repetitive stimuli.

Diurnal and Nocturnal Rhythms.—The familiar phenomena of day and night and their time variations in the procession of the equinoxes may be used as an analogy which lends itself simply to translation into

sound and movement concepts. Figure 1 illustrates the peak changes in the relationship of day to night in the winter and summer solstices. The sequence of events in time is that of the grouping of day and night. The peak points of the four seasons represent four sequences. The intensities of the two events which compose the sequence are not con-

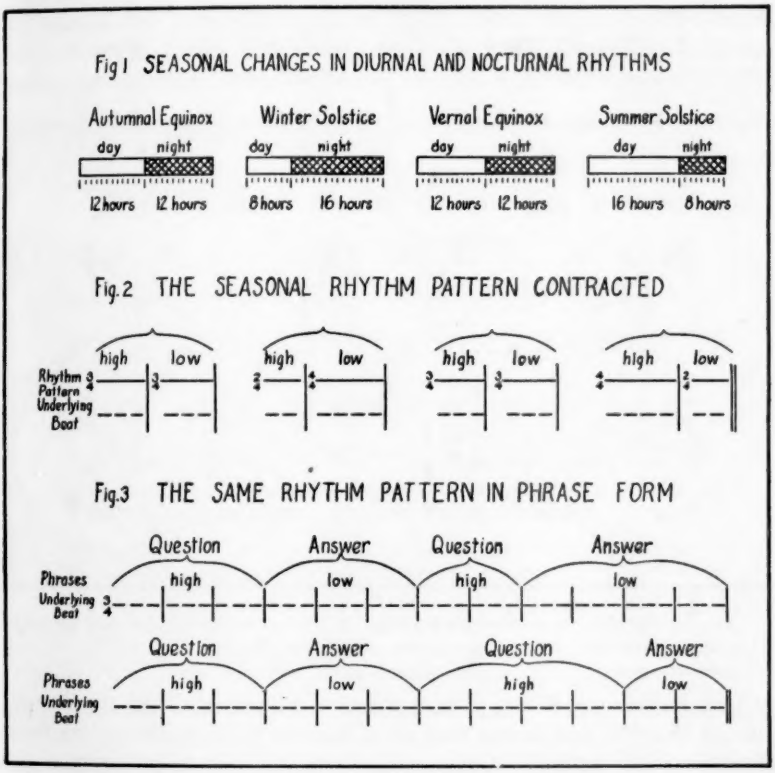


FIG. 2. Play the first measure of each sequence upon a highpitched drum and the second measure upon a low-pitched drum.

FIG. 3. Play the underlying beat in ¾ metre. This is arbitrarily chosen. Play the question or antecedent phrase upon a high-pitched drum and the answer or consequent phrase upon a low-pitched drum.

stant. Day may be conceived as a visual accent, night as an event devoid of accentual qualities. The durations of the events in the sequences are so related as to make a pattern. Cycles during which day and night reach approximate equality in length alternate with cycles during which day is either shorter or longer than night. The first and third sequences repeat themselves identically, the alternating second and fourth being variations.

The Diurnal and Nocturnal Rhythm Developed into Sound Patterns.—The feel of the seasonal diurnal and nocturnal rhythm may be more easily obtained by reproducing it in sound, as for example, upon two drums. To further simplify its reproduction, the original rhythm pattern may be contracted to one-quarter its size. When the time relationships between day and night are represented as *the number of quarter note values to a measure,* the metrical pattern which results may be scored as in Figure 2. When the time relationships represent *the number of measures in a phrase,* a more extended variation of the same rhythm

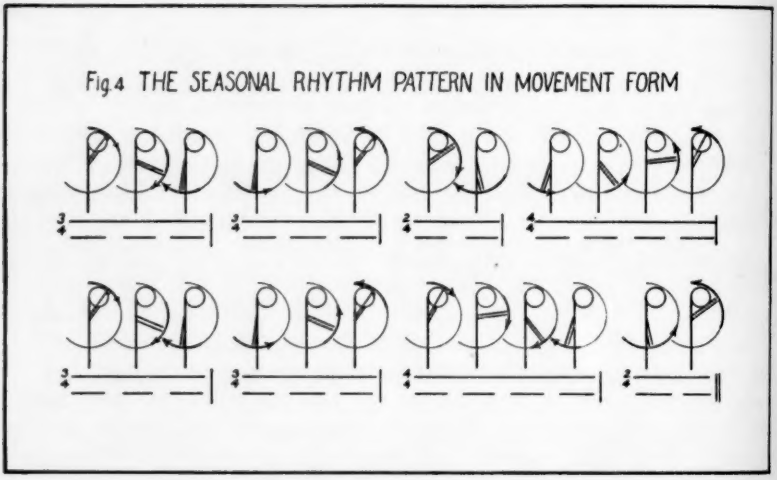


FIG. 4. Perform the downward swing of the arms during the first measure in each sequence and the upward swing during the second measure.

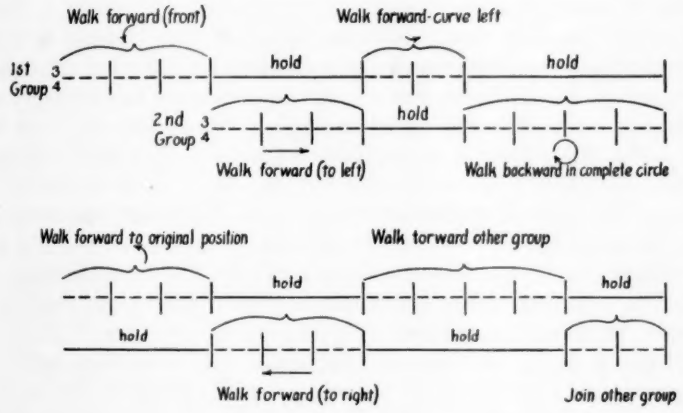
pattern is obtained. This is illustrated in Figure 3. Thus the strong, pulsing beats of two drums may be utilized to enhance the feeling tone of the familiar pattern of the seasons.

The Diurnal and Nocturnal Rhythm Developed into Movement Patterns.—A still stronger impression of the rhythm pattern under discussion may be achieved by translating it into movement timed to the drum study which has already been presented. This may be accomplished, as illustrated in Figure 4, by a circling swing of the arms in the antero-posterior vertical plane. The kinesthetic feel may be further intensified by the substitution of a moving for a stationary base. If two groups are used, as illustrated in Figure 5, one may move only on the first, or antecedent phrase, the other, on the second or consequent phrase, and variety may be given by changing the static attitudes of alternate phrases to slow sustained movements or to pulsations in phase with the underlying beat of the accompaniment.

Rhythmic Organization of Music.—The rhythmic organization of

music, though fundamentally similar to that illustrated in the sound and movement sketches given above, is one of greater complexity and refinement. While there are no generally accepted symbols for recording movement patterns, music utilizes a mathematically accurate system of signs denoting sounds of different durations. There are whole, half, quarter, eighth, and sixteenth note values. A quarter note has the approximate duration of a step in a normal walk tempo. An eighth note is twice as fast; a half note, twice as slow. Melodies are simple or intricate figures constructed from these long and short note values. These

Fig.5 THE PHRASE FORM OF THE SEASONAL RHYTHM PATTERN IN MOVEMENT



figurations are sometimes purely decorative. Often they give lightness and buoyancy to the progression of the music. Musical compositions devoid of melodic configuration would feel slow and heavy.

According to the habits of man, day and night are measured in hours. In music note values are grouped into measures by underlying pulse beats. Metrical signs indicate the total number of pulse beats to a measure. The first pulse is an accented beat, a stronger or louder sound which paces the grouping. Simple metres have one strong accent and one or two unaccented beats. Compound metres have both a strong, primary accent and another, less strong secondary accent. Mixed metres are frequently used in contemporary music. For example, two measures of 3/4 may be followed by one measure of 6/8; a 5/4 measure by a 3/4 measure. An attempt is made to achieve balance asymmetrically.

The grouping of measures into phrases is one of the most important

rhythms in music. The feeling of the cadence or the close which marks the phrase division is dependent upon the harmonic structure of the music. Cadences normally come at the end of 2, 4, or 8 measures and may be complete, as a period after a sentence, or, incomplete, as a comma in a sentence. As the phrases are grouped into larger units, ranging from the simple 2 and 3 part song forms to the sonata and symphony, the rhythmic analysis of music becomes a study of "form."

Rhythmic Organization of Dance.—The rhythmic organization of dance is one of patterns built more on pulse than upon complex variations. As a whole, the rhythms of dance do not become as decoratively elaborate as those of music. *Some dances are built primarily upon the pulse beat.* In primitive dances, the performers sway, stamp, or walk monotonously on the beat, and the strong feel of the pulse is the most distinguishing characteristic of this type of dance. Folk dances, which are built upon the patterns of the waltz, mazurka, polka, schottische, march, and polonaise, are slightly more elaborate derivatives of dances built upon the pulse beat. Variations are only infrequently added to these simple steps. They never approach the complexity of the melodic figuration of music. *Some dances are characterized by flowing movements* that have little feeling of beginning and ending except in very large units. They have a strong breath phrase feeling but little pulse accent or duration pattern. Flowing movements have the same function in dance that melodic patterns serve in music. They are decorative and have the capacity for creating the illusion of motion beautifully light and ethereal in its qualities as contrasted with the monotonous heaviness of a perpetual pulse accentuation. *Other dances are built upon dramatic ideas and movements of pantomimic significance.* These are analogous to prose rhythms in literature. The grouping, repetition, strength, or duration of the movement patterns are motivated more by the idea behind the composition than any abstract principles of aesthetic balance. Finally, *contemporary dance lends itself preeminently to rhythmic treatment,* because it speaks with percussive, clean-cut, and definite movements. It is built primarily upon the pulse, but unlike primitive dance, utilizes unusual and interesting irregularities in the grouping of accents. This contributes a basic emotional appeal upon which are superimposed complexities of rhythmic treatment which give to contemporary dance its unique and brilliant eloquence. There has been a trend toward the use of contemporary music for the accompaniment to contemporary dance. Much of this is also built upon highly complicated irregular metrical schemes. The contemporary dancer is, in general, less interested in the evolution of intricate rhythmic patterns than the clean expression of pulse, phrase, and metre.

Rhythmic Organization as the Unifying Factor in the Relation of Music to Dance.—A generally satisfying association of music and movement concepts may be attained in a variety of ways. *A musical compo-*

sition may be chosen first. The structure of the dance will then be most influenced by the underlying pulse beat or will follow the large phrase patterns of the music with flowing movements. Either of these may thus become the unifying factor between the two art forms. The dominant quality will be contributed by the music. Conversely, *the dancer may compose a movement study to which the musician writes an accompaniment.* This is especially preferred by modern dancers. The musician may then take the identical rhythmic durations, intensities, tempos, and phrase structure and duplicate them in sound. Or he may take the underlying metrical scheme and create a subordinate accompaniment aimed at intensification of the pulse feel rather than the rhythmic pattern of the movement. Finally, he may compose a contrapuntal pattern in sound against the rhythmic pattern in movement. In certain highly dramatic, prose-like dances, a *mood background* with little relationship to the movement may be used to heighten the emotional content of the dance composition. In all instances, to give these separate art forms a satisfactory union, it is of prime importance that the fundamental rhythmic components of the two media of expression be in harmony with each other.

Prediction of Time in Swimming Breast Stroke Based on Oxygen Consumption

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IN ANY race the maximum speed which can be developed depends on the extent to which the body metabolism can be raised and the efficiency of muscular performance.

Chemical processes involved in muscular metabolism may be divided into two parts: anaerobic—which does not require the presence of oxygen and aerobic which requires oxygen. Short races may be performed without breathing, utilizing the anaerobic phase of the chemistry of muscular contraction. The limit of exertion will be determined by the subject's tolerance to the accumulation of the waste products, mainly lactic acid.

In longer races a supply of oxygen during the race is imperative. If the pace is moderate this intake may meet all the needs. If the pace is great enough the amount of oxygen assimilated during the race becomes inadequate and the unoxidized substances begin to accumulate.

Man's tolerance to the fatigue products can be measured by the excess amount of oxygen needed in order to bring metabolism back to the pre-exercise conditions. This amount is denoted as the oxygen debt.

Sargent[6]* under the direction of A V. Hill, showed that it was possible to predict the speed in track running if the following factors are known: 1. Oxygen requirement for various speeds; 2. Maximum oxygen debt; 3. Maximum oxygen intake per minute while running.

Greene[1] under the direction of Karpovich, verified this and also proved that this can be applied to crawl stroke swimming.

In both running and crawl swimming, propelling force is applied in such a manner that there is comparatively little fluctuation in the speed with which the athlete moves.[2,3,4,5]

In breast stroke on the other hand, speed fluctuation within each stroke cycle is great.[3] The present writers decided to find out whether Sargent's method of prediction can also be applied to this stroke.

EXPERIMENTAL PROCEDURE

The subject was 21 years of age, weighing 169 pounds and 70.5 inches in height, a good varsity team swimmer, at the peak of his seasonal training.

Tests were performed in the 60-foot College swimming pool in the morning, the subject having no breakfast. Each time his resting metab-

* Refer to numbered Bibliography at end of article.

olism was determined in a sitting position, after which the subject was given a swimming test.

Theoretically, resting metabolism should have been determined in the lying position in water, but that would have involved some practical difficulties such as unavoidable shivering after the subject had been lowered quietly into cool water (70°). Our error, if any, cannot be large. Schmelkes[7] showed that resting metabolism in water may be about 11 per cent higher than on the land but since we used the sitting position, we obtained a higher metabolic rate than in the lying position, thus reducing the error.

On the other hand, the short duration of swimming tests in our experiment (under 1 min.) would require a small correction, which may be safely disregarded.

OXYGEN REQUIREMENT FOR THE VARIOUS SPEEDS

The subject started swimming with a dive and on each turn he used a vigorous push-off. The speeds chosen for the tests were approximately within the range of competitive tank swimming. As the subject was an experienced swimmer, the performance was always close to what was expected. Needless to say, the pace was kept as uniform as possible. At the completion of the test, during which he held his breath, he immediately started breathing into a Douglas bag while still being in water. Then he was lifted out of water, placed in a comfortable chair, dried and covered with a bathrobe. In this position his expired air was collected for a length of time varying from 30 to 45 minutes, depending on the intensity of the exertion. The excess of the oxygen used during recovery over the amount of oxygen which would have been ordinarily used during the same length of time, if the subject had no preliminary swim, is the oxygen debt.

A number of preliminary tests were made to accustom the subject to the discomfort of testing. Duplicate samples of air were taken from the bags for analysis. In spite of these precautions only about half of the tests were acceptable due to various mishaps. The results of these tests are given in Table I. The column headed "Total O_2 used Liters" shows the extent of the oxygen debt incurred in each test. It therefore indicates how much oxygen is needed in order to maintain a

TABLE I

OXYGEN REQUIREMENT FOR CERTAIN SPEEDS IN BREAST STROKE SWIMMING

Swimming distance in feet	Time sec.	Speed ft./sec.	Total O_2 used Liters	O_2 required per 1 min. Liters
120	43.5	2.76	2.246	3.1
120	37.0	3.24	4.281	6.95
180	51.0	3.53	8.044	9.46
180	45.0	4.00	10.320	13.78

certain speed (found in the third column). As it may be observed *10.32 L represent the maximum oxygen debt possible for this subject.*

The data for speed and oxygen required per minute are presented conveniently in Fig. I.

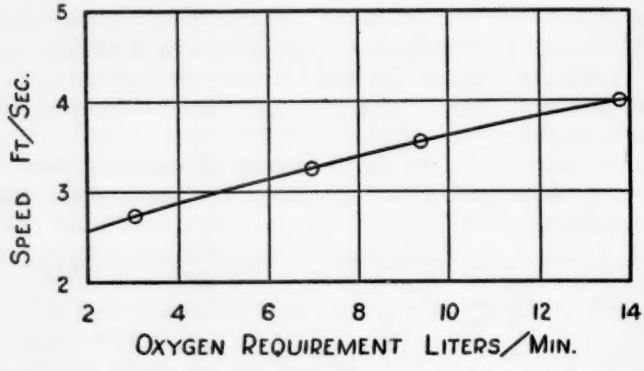

FIG. I

The line in Fig. I doubtless would have been more curved if additional data had been available, yet since it is the tail of the whole curve it is naturally straighter than its beginning. Since we did not use very low rates of speed the beginning of the curve has been omitted. With this graph it is possible to tell the amount of oxygen required for any speed within the limits of the graph.

DETERMINATION OF THE OXYGEN INTAKE DURING SWIMMING

Oxygen intake was determined during a stationary swim of 30 strokes per minute. The subject was attached by means of a rope to a post on the edge of the pool, and expired air was collected in a series of Douglas bags.

It is of interest to note that the maximum intake was practically reached by the end of the first minute; first minute—3.747 L., second minute—3.806 L., third minute—3.877.

PREDICTION OF THE DISTANCE WHICH CAN BE COVERED IN A GIVEN TIME

For this purpose it was assumed that each time the swimmer used a maximum speed compatible with the duration of the swim and that the entire amount of oxygen "available" (oxygen debt plus total oxygen intake) was completely exhausted.

First it is necessary to calculate the amount of oxygen available for the whole time, then the rate of its use per minute. Knowing the rate per minute, we can find from Fig. I a corresponding speed. By multiplying speed by time, the corresponding distance is obtained. Table II illustrates this procedure.

TABLE II

THE DISTANCE COVERED IN A GIVEN TIME WHEN CORRESPONDING MAXIMUM SPEEDS ARE USED

Time in min., T	1	2	3	4	5	8
Max. O_2 debt, D. Liters.....	10.32	10.32	10.32	10.32	10.32	10.32
O_2 Intake, I*, Liters.....	3.52	7.15	10.94	14.58	18.23	29.17
Total O_2 "available"..... (D+I)	13.84	17.47	21.26	24.90	28.55	39.49
O_2 available per 1 min..... (D+I) : T	13.84	8.73	7.08	6.22	5.71	4.94
Corresponding speed, S ft./sec. (found in Fig. I)	4.02	3.52	3.30	3.20	3.13	3.03
Distance covered, in ft. .... (SxT)	241	422	594	768	939	1454

* Figures in this row are net, the resting consumption of oxygen having been subtracted.

The computed distances were plotted against the time on Fig. II. On the same graph we indicated the average actual times for some

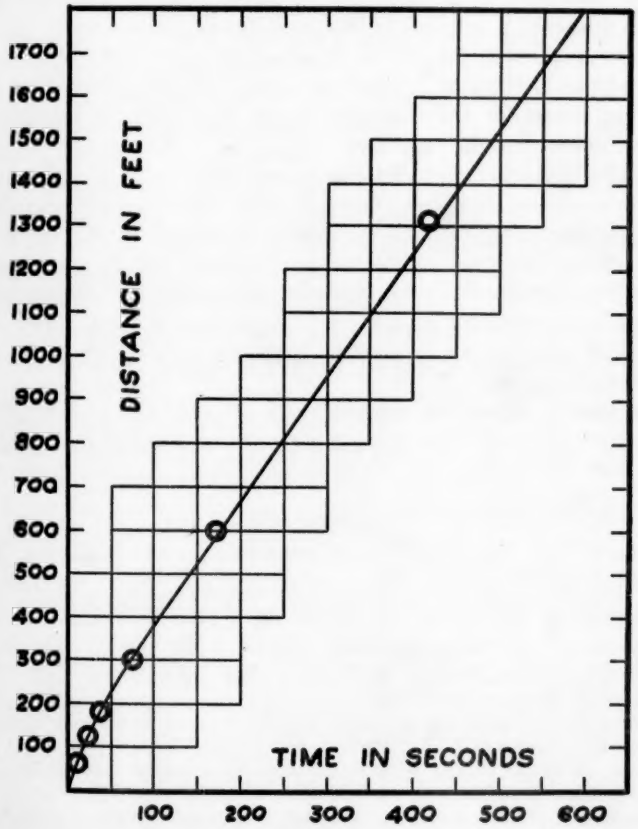

FIG. II

distances. As may be seen, they lie close to the line of prediction. The original working graph was drawn on a larger scale to make reading easier.

Table III represents a comparison of the actual and predicted times for several distances.

TABLE III

COMPARISON OF THE ACTUAL AND PREDICTED TIME FOR BREAST STROKE SWIMMING

Distance in ft.	Actual time in sec.	Predicted time in sec.
60	12.7	12.7
120	26.0	27.0
180	44.5	46.0
300	76.7	72.5
600	173.0	180.0
1320	420.0	430.0

CONCLUSION

The method used by Sargent for prediction of running time for various distances is applicable to breast stroke swimming.

By testing man's maximum oxygen intake, maximum oxygen debt and oxygen requirement for various speeds it was possible to predict swimming times for the distances up to 1320 feet, while the testing distance never exceeded 180 feet.

Besides theoretical interest this investigation is of some pedagogical value in coaching. It shows clearly that an improvement in swimming can be obtained only through an increase in oxygen intake, oxygen debt and improved efficiency of the stroke. Capacity for oxygen intake and debt will be increased through intensive swimming; the efficiency of the stroke will be improved by bettering the swimming form, which will reduce water resistance and develop a greater speed with a lower consumption of oxygen.

We want to thank our experimental subject, Mr. George Murphy, for his patience and cooperation during this investigation, and also Dr. D. B. Dill of the Harvard Fatigue Laboratory for the loan of some necessary equipment.

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Strength Tests as Measures of General Athletic Ability in College Men

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NUMBERS of studies relating to strength tests as measures of general athletic ability are available but such studies have been made almost entirely in the secondary field. The original Rogers' strength test battery[1] was validated as a measure of general athletic ability for high school boys and since that time the assumption has been that strength tests are valid measures of general athletic ability for boys and men beyond the secondary school level.

The purpose of this study is fourfold:

1. To devise a battery of strength tests for use with college men in measuring general athletic ability

2. To test the usefulness of the following measures in predicting general athletic ability with college men:

a) Rogers' Arm Strength Index

b) Rogers' Short Strength Index

c) Rogers' Strength Index (without lung capacity)

d) McCloy's formula for predicting strength by chinning and dipping

e) The best possible empirical formula

3. To discover the effect on Cozens' General Athletic Ability Test of the substitution for dips of the following measures:

a) Rogers' Arm Strength Index

b) McCloy's Arm Strength Index

c) An empirical Arm Strength Index

d) Chins plus dips

4. To devise a short battery of tests for measuring the strength of college men.

The subjects used in the study were 250 entering college men (unselected) at the University of California at Los Angeles. The tests were given in the fall of 1937.

The criterion used for general athletic ability was Cozens' General Athletic Ability Test,[2] a weighted battery consisting of the following individual tests: baseball throw for distance, football punt for distance,

[1] Frederick Rand Rogers, *Physical Capacity Tests in the Administration of Physical Education*, Contributions to Education No. 173, 1925. (New York: Teachers College, Columbia University).

[2] Frederick W. Cozens, *Achievement Scales in Physical Education Activities for College Men* (Philadelphia: Lea and Febiger, 1936), p. 114.

TABLE I

INTERCORRELATIONS—GENERAL ATHLETIC ABILITY TESTS AND STRENGTH TESTS—COLLEGE MEN

	Criterion	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Mean	Sigma
																					Criterion		325.5	76.6
1 Baseball Throw	.725	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	163.18′	25.80′
2 Football Punt	.604	.471	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	34.07yd.	7.00
3 Bar Snap	.569	.311	.292	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5-9.36″	11.97″
4 Stdg. B'd. Jump	.719	.469	.368	.388	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7′-7.24″	7.44″
5 Dodging*	.602	.315	.223	.356	.377	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	23.83s	1.04s
6 300 yards*	.756	.399	.304	.336	.513	.455	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	44.43s	4.01s
7 Dips	.592	.389	.247	.484	.424	.256	.413	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7.67	4.12
8 Chins	.453	.288	.106	.498	.327	.244	.329	.601	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6.78	3.30
9 Rogers' A.S.	.613	.445	.309	.538	.466	.301	.443	.855	.777	...	...	...	...	...	...	...	...	...	...	...	...	...	351.4	165.6
10 McCloy's A.S.	.435	.360	.368	.145	.236	.091	.185	.430	.253	.507	...	...	...	...	...	...	...	...	...	...	...	...	238.3	32.6
11 Back Lift	.344	.308	.210	.276	.312	.249	.335	.398	.299	.430	.658	...	...	...	...	...	...	...	...	...	...	...	343.0	66.0
12 Leg Lift	.393	.296	.204	.312	.315	.326	.343	.355	.259	.473	.503	.618	...	...	...	...	...	...	...	...	...	...	616.8	131.6
13 Knee Resist	.369	.288	.211	.225	.423	.232	.256	.354	.199	.402	.441	.424	.335	...	...	...	...	...	...	...	...	...	96.6	24.35
14 Knee Pull	.276	.197	.218	.238	.276	.172	.191	.242	.183	.342	.414	.405	.325	.521	...	...	...	...	...	...	...	...	73.2	13.05
15 Arm Push	.334	.264	.317	.237	.275	.198	.243	.334	.236	.461	.534	.474	.335	.302	.280	...	...	...	...	...	...	...	252.4	70.6
16 Arm Pull	.296	.252	.221	.203	.266	.200	.209	.283	.308	.411	.483	.410	.300	.378	.315	.351	...	...	...	...	...	...	78.6	15.4
17 Right Grip	.282	.258	.181	.137	.292	.154	.251	.273	.183	.382	.551	.613	.466	.430	.344	.335	.400	...	...	...	...	...	124.2	19.50
18 Left Grip	.298	.302	.218	.206	.244	.221	.200	.300	.242	.413	.523	.608	.454	.358	.253	.336	.378	.660	...	...	...	...	112.7	17.25
19 Chins + Dips	.592	.383	.207	.542	.421	.264	.412	...	...	...	...	.394	.338	.315	.242	.305	.330	.254	.313	...	...	...	15.22	6.66
20 Age	.176	.169	–.017	.090	.196	.148	.124	.200	.216	.233	.159	.211	.294	.078	.027	.127	.116	.250	.165	.245	...	...	18.03	1.38
21 Height	.192	.243	.346	.070	.196	.120	.188	–.061	–.144	.243	.493	.312	.395	.231	.200	.349	.159	.299	.281	–.113	.016	...	69.33	2.62
22 Weight	.050	.230	.308	–.051	.085	–.028	.043	.020	–.158	.199	.942	.534	.409	.327	.339	.445	.362	.458	.423	–.068	.086	.554	147.12	17.82

* Positive correlation coefficients result from the use of achievement scores instead of raw scores.

bar snap for distance, standing broad jump, dodging or maze run, 300-yard run,[3] and dips.

The following strength tests were given according to Rogers' procedures:[4] back lift, leg lift, right grip, and left grip. Chins were made on a horizontal bar and dips on the parallel bars. To these were added arm push, arm pull, knee resistance and knee pull, all determined by dynamometer readings. In the arm push and arm pull the dynamometer was held in front of the chest, arms at shoulder level, with elbows bent and hands grasping the dynamometer handles. The knee resistance is a measure of thigh flexor strength and the technique used follows that set up by Anderson.[5] In the knee pull, the subject's knees are flexed at a right angle and pull on a strap attached to a dynamometer. All dynamometers were calibrated prior to the experiment.

PROCEDURE

Intercorrelations of all test items were calculated by the product-moment method and are shown in Table I. Since the intercorrelations of the general athletic ability tests were computed from the data at hand, it seemed best also to compute new correlation coefficients of the test items with the criterion. This procedure will, of course, produce a slightly higher multiple correlation coefficient with the criterion $R = .972$ as against $R = .967$, but it appears illogical to use original criterion correlations with new intercorrelations.

In computing multiple correlation coefficients (R) and weights of battery test items, when substitutions for dips were made in the General Athletic Ability test, Kelley's Method of Successive Approximations[6] was used.

ANALYSIS AND DISCUSSION OF DATA

Rogers' Arm Strength Index, computed by the formula $(\text{chins} + \text{dips}) \times \left\{ \frac{\text{Weight}}{10} + (\text{height} - 60) \right\}$, was substituted for dips in the battery of General Athletic Ability Tests. The resulting multiple correlation coefficient of $R = .968$ is lower than was obtained using dips alone, showing that it is not as good a measure for the battery as dips alone.

The size of the intercorrelations indicates that the substitution of either Rogers' Short Strength Index or his Strength Index (less lung capacity)[7] will not produce a higher multiple correlation coefficient than

[3] In the original battery the 440-yard run was used, but recent experimentation (unpublished) has shown that the 300-yard run is a better test administratively and its use does not change the relationship between the battery and the criterion.

[4] Frederick Rand Rogers, *Physical Capacity Tests* (New York: A. S. Barnes and Company, 1931).

[5] Theresa W. Anderson, "Weighted Strength Tests or the Prediction of Athletic Ability in High School Girls," RESEARCH QUARTERLY, VII, No. 1 (March, 1936), 137.

[6] Truman L. Kelley, *Statistical Method* (New York: The Macmillan Company, 1924), pp. 302–310.

[7] It has been shown by McCloy, Cureton, and Van Dalen that lung capacity is of little significance as an element in the strength test.

was produced by the substitution of his Arm Strength Index (See Table II).

McCloy's Arm Strength Index calculated by the formula (1.77 weight + 3.42 chins — 46), when substituted for dips in the battery of General Athletic Ability Tests, produces an R of .974 slightly higher than when dips is included ($R = .972$).

Substituting (dips plus chins) for dips in the battery does not increase the multiple relationship ($R = .972$).

TABLE II

CORRELATIONS OF STRENGTH TEST BATTERIES WITH GENERAL ATHLETIC ABILITY TEST ITEMS

General Athletic Ability Elements	Rogers' Arm Strength	Rogers' S.S.I.	Rogers' Str. Index
Criterion	.613	.583	.567
Baseball Throw	.445	.456	.435
Football Punt	.309	.311	.299
Bar Snap	.538	.451	.465
Standing Broad Jump	.466	.470	.460
Dodging	.301	.289	.338
300-yard Run	.443	.430	.451

Ten strength test items were placed in a battery to determine their usefulness for predicting athletic ability. These included back lift, leg lift, knee resistance, knee pull, arm push, arm pull, right grip, left grip, chins, and dips. Five of these either show negative or such low positive regression coefficients as to be valueless. The final battery consists of leg lift, knee resistance, arm push, chins and dips, and produces an R of .651.

When McCloy's Arm Strength Index is substituted for chins and dips in this battery the R becomes .518 with the following five test items remaining: leg lift, knee resistance, arm push, arm pull, and McCloy's Index. When used with other strength tests, McCloy's Index is not as valuable as Rogers' Arm Strength Index for predicting general athletic ability in college men.

Rogers' Arm Strength Index substituted for chins and dips in the strength test battery produced an R of .635 with the following items having positive regression coefficients: leg lift, knee resistance, arm push, and Rogers' Arm Strength Index.

Adding the factors of age, height, and weight to the strength tests produces a battery having an R of .667 with nine items: chins, dips, leg lift, knee resistance, height, knee pull, arm push, arm pull, and age. The regression coefficients of the last four items are so small as to be negligible and the regression equation of the final battery of five tests proposed for use is

$$\overline{X}_0 = 4.00X_1 + 7.80X_2 + .053X_3 + .356X_4 + 5.40X_5 - 203.0$$

Where $\overline{X}_0$ = Estimated General Athletic Ability
X_1 = Chins
X_2 = Dips
X_3 = Leg Lift
X_4 = Knee Resistance
X_5 = Height
R = .666

σ (est) = 57.1 which is a little over 25 per cent better than a guess.

The factor of height, appearing prominent as it does in this regression equation, would lead one to believe that it may help the battery of general athletic ability tests. When added to this battery, however, its regression coefficient becomes slightly negative.

Since height is always taken at the time of the General Athletic Ability test, a combination of chins, dips, age, height, and weight may prove valuable as an arm-strength measure to be used in place of dips alone. Only height proved to be useful in combination with chins and dips. These factors were combined into an index with three different sets of data as follows:

Data of Table I:

Index= .61 Chins + 1.24 Dips + Height; R = .653

Additional Data (Set 1):

Index= 1.04 Chins + 1.08 Dips + Height; R = .686

Additional Data (Set 2):

Index= .87 Chins + 1.10 Dips + Height; R = .661

The easiest index to use would be one, not an average of the three, but fairly close: Index = Chips + Dips + Height. Such an index was used on the individuals involved in this study with a resulting R of .645 with the criterion. The index is easy to compute and the loss in efficiency is small when it is compared with the index derived from the data of Table I, R = .645 as against R = .653. It also appears to be better than either Rogers' Arm Strength Index or McCloy's Arm Strength Index as a rough strength test measure to be used with college men in estimating general athletic ability. It does not, however, combine well with the other items of the General Athletic Ability Test because of higher intercorrelations with these items. As a matter of fact it reduces the R from .972 to .969 when substituted for dips alone.

THE DEVELOPMENT OF A SHORT BATTERY OF STRENGTH TESTS

In attempting to establish a battery of strength tests for measuring general athletic ability, data were collected on ten strength test items. Table III indicates the strength test intercorrelations. It seems reasonable to assume that these in combination will make a satisfactory criterion of strength. Since chins and dips are important strength test items and would add nothing to the criterion if scored as collected, the following procedure was used in scoring:

TABLE III

INTERCORRELATIONS—STRENGTH TESTS—COLLEGE MEN

	Crite-rion	Back Lift	Leg Lift	Knee Resist	Knee Pull	Arm Push	Arm Pull	Right Grip	Left Grip	Chins	Dips	Age	Height	Weight
Back Lift	.828	...	...	...	...	...	...	...	...	...	...	...	...	...
Leg Lift	.831	.618	...	...	...	...	...	...	...	...	...	...	...	...
Knee Resist	.550	.424	.335	...	...	...	...	...	...				...	...
Knee Pull	.480	.405	.325	.521	...	...	...	...	...	Criterion	M = 2005.9		...	...
Arm Push	.616	.474	.335	.302	.280	...	...	...	...		σ = 305.0		...	...
Arm Pull	.485	.410	.300	.378	.315	.351	...	...	...	...	...	...	...	...
Right Grip	.611	.613	.466	.430	.344	.335	.400	...	...	...	...	...	...	...
Left Grip	.624	.608	.454	.358	.253	.336	.378	.660	...	...	...	...	...	...
Chins	.496	.299	.259	.199	.183	.236	.308	.183	.242	...	...	...	...	...
Dips	.630	.398	.355	.354	.242	.334	.283	.273	.300	.601	...	...	...	...
Age	.260	.211	.294	.078	.027	.127	.116	.250	.165	.216	.200	...	...	...
Height	.360	.312	.395	.231	.200	.349	.159	.299	.281	—.144	—.061	.016	...	...
Weight	.443	.534	.409	.327	.339	.445	.362	.458	.423	—.158	.020	.086	.554	...
Chins + Dips	.635	.394	.338	.315	.242	.305	.330	.254	.313	...	...	.245	—.113	—.068
McCloy's Arm Strength	.661	.658	.503	.441	.414	.534	.483	.551	.523	.253	.430	.159	.493	.942
Rogers' Arm Strength	.757	.530	.473	.402	.342	.461	.411	.382	.43	.777	.855	.233	.243	.199

1. The average of the lowest three (arm push + arm pull) is 150.

2. The standard deviation of (arm push + arm pull) is 80; of (chins + dips) is 6.66.

3. Since (chins + dips) should be worth at least as much as (arm push + arm pull), they may be scored by adding to 150 the number of (chins + dips) times $\frac{80}{6.66}$ or 12, the differential in standard deviations. Thus 6 chins + 7 dips would be scored $150 + (12 \times 13) = 206$.

4. Such a procedure does not weight the strength criterion unduly.

In attempting to establish the weight of the items in the battery, the factors of age, height, and weight were added to the strength tests. The items of right grip, age, height, and weight showed negative weights, and the weights of knee pull and arm pull became very small. However, this battery of nine items has an R of .990 with the criterion. Since the tests of knee resistance and knee pull are difficult to administer on account of the fact that subjects must be strapped to a table they were eliminated as was also arm pull. Left grip was eliminated on account of its small regression coefficient, leaving a battery consisting of back lift, leg lift, arm push, chins, and dips. This battery has a high multiple correlation with the criterion (R=.982) and is rather simple to administer. Its regression equation is

$$\overline{X}_0 \text{ (estimated strength)} = 1.533 \text{ Back Lift} + 1.052 \text{ Leg Lift} + .938 \text{ Arm Push} + 10.9 \text{ Chins} + 14.94 \text{ Dips} + 405.6$$

McCloy's Arm Strength Index and Rogers' Arm Strength Index were substituted in this short battery for chins and dips with R's of .9505 and .9803 respectively, indicating that neither index is as valuable as chins and dips. The reduction in multiple correlation coefficients is undoubtedly linked up with the fact that both indices include the factor of weight.

The muscle group sampling in the short battery of tests agrees fairly well with Wendler's [8] study which used as a criterion the strengths of 47 different muscle groups.

SUMMARY AND CONCLUSIONS

During the fall of 1937 data were collected on ten strength tests and a number of combinations using 250 unselected college men. These data were studied in relation to:

1. Their usefulness in predicting general athletic ability using as a criterion Cozens' General Athletic Ability Test, and

2. A possible substitute for dips in the General Athletic Ability Test.

3. The formulation of a short battery of tests for measuring strength.

The following conclusions were drawn:

1. The following strength tests cannot be considered valuable for

[8] Arthur J. Wendler, "An Analytical Study of Strength Tests Using the Universal Dynamometer," SUPPLEMENT TO RESEARCH QUARTERLY VI, No. 3 (October, 1935), 81–85.

predicting the general athletic ability of college men. Despite sizeable correlations with the criterion, the standard errors of estimate are much too large for reasonable estimation.

A combination of chins, dips, leg lift, knee resistance, and height, $r = .666$*

An empirical index of chins + dips + height, $r = .645$

Rogers' Arm Strength Index, $r = .613$

Chins + dips, $r = .592$

Rogers' Short Strength Index, $r = .583$

Rogers' Strength Index (less lung capacity), $r = .567$

McCloy's Arm Strength Index (as computed by the formula $1.77W + 3.42C - 46$), $r = .435$

2. For rough estimations, the index of Chins + Dips + Height is probably the most useful because of the factor of speed in administration.

3. The only substitute for dips in the battery of general athletic ability tests which increased the multiple correlation coefficient was McCloy's Arm Strength Index. This increase is relatively small from $R = .972$ to $R = .974$. Though McCloy's Index has a much lower correlation with the criterion of ($r = .435$) than Rogers' Arm Strength Index ($r = .613$), the intercorrelations with the other items in the battery are also much lower, resulting in an increase in the multiple relationship. However, the increase is not sufficient to justify the additional computations necessary. As an element of arm strength in a general athletic ability test for college men, dips on the parallel bars is the most useful single measure.

4. The factors of age and weight, so prominent in Rogers' Strength Index for high school boys, have no significance in a strength index designed to predict general athletic ability in college men. The factor of height, however, becomes rather prominent in an index for college men. Rogers' found the reverse to be true with high school boys.

5. Great differences exist between high school boys and college men insofar as the relationships among the factors of age, height, and weight are concerned. The same holds true of the relationships between these factors and strength test items. In view of these facts, secondary school performance data should not be used as a basis for extending strength test norms into the college age level.

6. Using ten strength test items as a criterion, a short battery of strength tests was formulated yielding an R of .982. This battery consists of five tests properly weighted: back lift, leg lift, arm push, chins, and dips. The factors of age, height, and weight yield small negative regression coefficients and should not be used in any battery purporting to measure the strength of college men.

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* The regression equation for this combination is

$\overline{X}_0 = 4.0$ chins $+ 7.8$ dips $+ .053$ leg lift $+ .356$ knee resist $+ 5.4$ height $- 203$.

A Further Study of the Optimum Time for Holding a Swimmer on His Marks

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THE factor determining the optimum interval of time that a swimmer should be held on his marks between the "set" and the "start" stimulus is the time required for attention to reach its peak. If the stimulus coincides with the peak of attention the interval between the stimulus and the initiation of performance will be shorter than if the stimulus occurs when attention is not at its peak. Theoretically this optimum holding time should be of the same duration for all racing events that start from the "set" position.

The interval of time that a swimmer should be held on his mark after he is "set" has been previously studied by Tuttle, Morehouse, and Armbruster.[1] In a similar experiment Walker and Hayden [2] ascertained the optimum time for holding a track sprinter on his marks. Tuttle, Morehouse, and Armbruster found the optimum holding time for the swimming start to be 2.0 seconds.

Walker and Hayden concluded that an interval of from 1.4 to 1.6 seconds between the "set" and the stimulus (gun shot) gives the shortest starting time in track sprinting.

A comparison of the two studies reveals a difference in technique that offers a possible explanation of the discrepancy between the results. The procedure followed by Tuttle, Morehouse, and Armbruster consisted of starting the watch as soon as the swimmer had assumed a position with both feet on the take-off board, and at the end of the designated interval the pistol was fired and the time noted. The procedure used by Walker and Hayden was to give the command "On your marks," "Get set," and the "Gun." As soon as the sprinter came to a momentary steadiness in the "get set" position, the watch was started, and at the end of the desired interval, the gun was fired. The difference in time between assuming a position with both feet on the board and

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[1] W. W. Tuttle, Laurence E. Morehouse, and David Armbruster, "Two Studies in Swimming Starts. II. The Optimum Time for Holding a Swimmer on His Mark," Research Quarterly, 10:1 (March, 1939), 92-98.

[2] G. A. Walker, and T. C. Hayden, "The Optimum Time for Holding a Sprinter Between the Set and the Stimulus (Gun Shot)," Research Quarterly, 4:2 (May, 1933), 124–130.

coming to a momentary steadiness in the "get set" position may explain the difference of .5 second in optimum holding time between the two studies.

OBJECT OF THE EXPERIMENT

The object of the experiment reported in this study is (a) to find whether or not there is a discrepancy between optimum holding times for the sprint start in swimming and in running; (b) to verify the optimum holding time for starting swimming races from the "set" position; and (c) to observe the differences of optimum holding times between trained and untrained swimmers.

THE TECHNIQUE

The apparatus employed consists of a sound key and starting board arranged so that when the gun was fired a relay was activated starting a Dunlap chronoscope hand. When the swimmer left the starting board electrical contacts were broken, thus activating the stop magnet and stopping the chronoscope hand. The chronoscope shows the time in milliseconds, elapsing between the gun shot and the instant the swimmer leaves the board, thus measuring the starting time.

The test was administered at approximately the same time each day, with a rest between trials. The holding times were determined by the same technique as that used by Walker and Hayden in measuring the optimum holding time for track sprinters. A tenth-second stop-watch was started as soon as the swimmer reached a period of momentary steadiness after the command "Get set" and the gun was fired when the hand of the stop-watch reached the desired interval.

THE DATA

Data were collected from thirty subjects; fifteen had experienced three or more years of competitive swimming and fifteen had no coaching in competitive swimming skills. Each subject was tested five times at each holding time interval of 1.0, 1.5, and 2.0 seconds. The average starting time at each holding interval was compared. A summary of the data is shown in Table I.

A study of the individual cases in the trained group shows that eight started faster using 1.5 seconds as the holding time, four were better with a holding time of 1.0 second, and three did best with a holding time of 2.0 seconds. This suggests that a holding time of 1.5 seconds is an advantage over 1.0 or 2.0 seconds as far as the starting time of the majority of trained swimmers is concerned.

Furthermore, the data in Table I show that untrained swimmers start faster after a holding time of one second as compared with 1.5 or 2.0 seconds in eight out of fifteen cases. Four did better at 1.5 seconds and three got away faster with a holding time of 2.0 seconds. The

advantage of the short holding time in case of untrained swimmers may be due to the fact that the attention of the swimmer is not complicated by the factors involved in preparation for a forceful start, but is directed mainly in getting off the mark in the shortest time.

TABLE I

SUMMARY OF THE MEAN STARTING TIME FOR EACH SUBJECT FOR EACH HOLDING TIME AS INDICATED

Subject no.	Holding time 1.0 sec.	Holding time 1.5 sec.	Holding time 2.0 sec.
	TRAINED SWIMMERS		
	sec.	sec.	sec.
1	1.041	1.010	1.025
2	.834	.805	.827
3	.855	.877	.804
4	.823	.828	.869
5	.910	.888	.909
6	1.114	1.059	1.047
7	.943	.983	.998
8	.994	.972	.976
9	.966	.938	.923
10	.992	.983	.991
11	1.078	.985	1.054
12	1.023	1.018	1.063
13	.898	.915	.970
14	1.063	1.086	1.085
15	.932	.921	.953
Mean	.964	.951	.966
	UNTRAINED SWIMMERS		
16	.999	1.005	1.007
17	.931	.912	.899
18	1.053	1.102	1.067
19	1.070	1.041	1.025
20	.982	.956	.985
21	.918	.965	.983
22	1.006	1.117	1.076
23	1.020	1.055	1.032
24	.959	1.032	1.085
25	1.013	1.029	1.010
26	1.072	1.108	1.087
27	1.065	1.034	1.082
28	1.026	1.052	1.040
29	.976	.993	.991
30	.933	.962	.987
Mean	1.001	1.0242	1.0243

Trained swimmers show distinctly shorter starting times than untrained in nearly every case, indicating that holding time is not the only factor involved in starting time.

The data collected in this study show that a trained sprinter requires about .96 second to get off his marks. The data presented by Tuttle, Morehouse, and Armbruster is in close correspondence to this figure,

their starting time mean being .98 second. The data further show that the untrained swimmer requires about 1.0 second to leave his mark.

SUMMARY AND CONCLUSIONS

The data obtained from a comparison of holding times with starting times of fifteen trained and fifteen untrained swimmers warrant the following conclusions:

1. A period of about 1.5 seconds is optimum for reaching the peak of attention during the start of either a swimming or sprinting race from a "set" position.

2. The optimum holding time for trained swimmers is approximately the same as that for trained track sprinters.

3. A holding time of 1.5 seconds gives a faster starting time for trained swimmers than either 1.0 or 2.0 seconds in the majority of cases.

4. The mean starting time of untrained swimmers is shorter when a holding time of about 1.0 second duration is used than when either 1.5 or 2.0 seconds is allowed because their attention is directed only toward getting off their marks, and is not so much concerned with the factors involved in the preparation for a forceful start.

5. On the basis of means a trained swimmer requires .96 second to leave his mark at the start of a race, while it requires an untrained swimmer 1.0 second.

This opportunity is taken to acknowledge the assistance of Walter D. Roy in collecting the data presented in this study.

A Study of the Primary Components of Cardiovascular Tests

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INTRODUCTION

CARDIOVASCULAR tests have been generally considered useful in the field of physical education for the purposes of evaluating physical fitness. It has been shown that muscular efficiency is modified by factors of circulation, nutrition and fatigue.[11, 31*] Since 1925, emphasis has been placed on the scientific approach to cardiovascular tests by investigators,[17, 32, 33, 36, 37, 38, 39] in which validation of cardiovascular tests has been studied. Statements made by administrators of physical education give further evidence of interest and emphasis on cardiovascular tests.[10, 64] They state that there has been long a need for cardiovascular tests of the type which can be administered by the trained physical education teacher for the purposes of classification when the services of a physician are not immediately available, or when the need is for the determination of athletic condition rather than of the relative degrees of health.

STATEMENT OF THE PROBLEM

The first purpose of this study was to analyze statistically, for their common and group components or primary components, thirty-two cardiovascular test variables of young women at the college level. Thurstone's method for determining multiple factors was utilized for this analysis.[53]

The second purpose was to formulate combinations of items which would give high multiple correlations with common components. If Thurstone's statement, that factor loadings represent zero-order correlations with the common components, continues to be substantiated by further research, then the regression weightings giving high multiple correlations with these criteria will be of value in quantitatively measuring these factors.

A REVIEW OF LITERATURE

A survey of literature dealing with cardiovascular tests reveals that studies may be divided into three groups according to the use of statisti-

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* Numbers refer to the Bibliography at the end of the article.

cal controls and in turn these groups may be studied according to the cardiovascular variables used.

Stages of Cardiovascular Development.—In the first stages of the development of cardiovascular testing the physiological functions were assumed; then tests were applied to attempt to prove or disprove the validity of the assumptions. Few of the tests have been checked for either reliability or validity by the use of any rigorous statistical controls.

In the second stage of the development of cardiovascular testing is found the beginning of scientific validation. Criteria were selected, a number of variables studied, and a test or battery chosen which was valid as determined by the criteria.

In the third period no new tests were proposed but a new method of analyzing tests was utilized, the analysis of multiple factors.

In the first stage of cardiovascular testing, the field covered by the literature was concerned with the following variables.

Arterial Pressure.—Two studies were made using arterial pressure as a variable. In the first study the systolic pressure was used in the horizontal position, together with changes of position from horizontal to standing and horizontal to sitting.[22] In a second study the systolic pressure was determined in the standing and lying positions, before and two or three minutes after exercise, and during a maximum lift.[35]

Blood Pressure and Heart Rates.—The differences in systolic pressure and heart rates in the reclining and standing positions were variables used to devise a test of condition.[15] The systolic pressure and pulse rates after rest, immediately after exercise, and five minutes later, were variables studied to determine the influence of exercise on a trained and an untrained man.[43] Changes in systolic, diastolic, and pulse pressures and heart rates were variables used to study effects of exercise on athletes in training after moderate, rapid, vigorous, fatiguing, and exhaustive exercise.[30] The pulse and diastolic pressures were variables used to express in percentage the myocardial load.[50] The product of pulse pressure times pulse rate taken simultaneously during rest and after a moderate amount of exercise was held to be a good index of oxygen absorption.[42] The resting systolic and diastolic pressures added together and multiplied by the resting heart rates were suggested as a method for determining functional capacity of the heart.[4, 5] A study of six variables was made that took into account heart rate in reclining and standing positions, increase in rate from reclining to standing, rate after exercise, the return to normal and the standing systolic pressure compared to the reclining systolic pressure.[44] The variables used in a study of some physiological effects on well and convalescent cases were pulse rates, systolic, diastolic and pulse pressures in the reclining and standing positions, and two indices p.p. $\times$ p.r. and Schneider's index.[25] The variables used in a simple test of physical fitness for muscular work were

pulse rates for one minute in standing, immediately after running forty-five steps in place in fifteen seconds, and after forty-five seconds rest.[18] Pulse rates were used to express physical efficiency numerically by the use of ratios. The sitting pulse rate for one minute was divided into the sitting pulse rate for two minutes taken immediately after walking up and down a special stair case for five minutes.[24] In a second study of physical efficiency by the pulse ratio, a stool thirteen inches high was used and the duration of the exercise was reduced from five to three minutes. Different rates of stepping on and off the stool were used to find two exercises, one of which would produce a pulse ratio below 2.5 and another a ratio slightly above 2.5.[19] The pulse-ratio test was later standardized [55] and simplified.[56]

After the standardization and simplification of the pulse-ratio test, the test has been used in physical education to:

1. Rate efficiency and physical fitness in specialized sports and gymnastic apparatus. [1, 46, 59, 60]

2. Point out differences in physical efficiency in high school boys[58] and college women.[57]

3. Determine the periodic fluctuation in physical efficiency during the menstrual cycle.[46]

4. Detect abnormal hearts.[12, 29, 41, 48]

5. Study the effect of exercises of graded intensity on leukocyte count.[54]

In the second stage of cardiovascular testing, the field of literature is very limited. In each of these researches a larger number of variables were studied.

Seventeen variables were studied in establishing biserial criteria of "poor" and "good" condition as a basis for developing a cardiovascular test.[32]

A series of three research articles of "good" and "poor" condition similar to study 32 followed. Twenty-six organic items were used, from which, by the use of the biserial and multiple correlations, a battery of five test items having high significance as measurements of physical condition were chosen.[37] In the second study of this series, the original organic efficiency test was revised. Sitting-pulse pressure was dropped and vital capacity was added to the battery. The organic measurements used in the revised battery were: sitting diastolic pressure, breath-holding twenty seconds after exercise, standing normal pulse rate minus pulse rate two minutes after exercise, standing pulse pressure, and vital capacity.[38] In the third study of this series, the validity of six cardiovascular tests was determined by the biserial technique. The tests studied were: the McCloy two-variable cardiovascular test,[32] Barach's cardiovascular test,[4] Tigerstedt's cardiovascular test,[49] the Stone cardiovascular test,[50] and the basal metabolic rate test.[38] The variables used in this study[39] were the same as in study two of this series.[38]

A study of the validity of the pulse ratio as a measure of physical efficiency was determined by correlating efficiency as determined by the pulse-ratio test with an endurance index. The variables used were: the resting pulse rate for one minute, and the pulse rate for two minutes after a light and a strenuous exercise.[17]

In the third period in the development of cardiovascular testing, no new tests were proposed but a new method of analyzing tests has been utilized.

This period is represented by a study in which fourteen cardiovascular variables were analyzed by the method of factor analysis.[33]

From the studies cited above, we have made a selection of the variables which have been proposed by various authors as having significance for testing. These variables are given under the procedure.

PROCEDURE

In an effort to study the primary factors in the cardiovascular system, a battery of thirty-two tests was set up. This battery consisted of twenty direct and twelve derived measures of cardiovascular tests.

The twenty direct measures used were: Pulse rates, systolic, diastolic, and pulse pressures taken in the reclining, sitting, and standing postures; pulse rates taken immediately after and one, two, and three minutes after a mild exercise of fifteen stool steps and immediately after and one, two, and three minutes after a strenuous exercise of thirty-five stool steps.

The twelve derived measures used were: Three each of pulse rates, systolic and diastolic pressures as altered by changes in posture, and three of pulse rates showing changes in recovery time after exercise.

Collection of Data.—The battery of 32 cardiovascular tests was administered to 123 unselected college women. Students offered themselves voluntarily as subjects. The average age was 19.4 years with a range from 16 to 26 years. Only students passed as healthy by the college physician were utilized.

Two checks of cardiovascular and physical condition of the young women were made by the college physician; one at the time of the physical examination and a second examination during the same week the cardiovascular tests for this study were made.

The students were given preliminary training in taking the examination. At this time the meaning of the pulse rates and blood pressures were explained and discussion by the subjects was encouraged. All the measurements were made in the morning during the months of March, April, and May. One subject an hour was scheduled and not more than four were examined during the morning. No other activities were going on and no other persons than the examiner and subject were allowed in the examination room at the time of the examination. If the subject appeared excited about any special event or had not followed her usual

habits, for example, not eating breakfast, or had a cold, or was menstruating, measurements were not made.

The subjects rested in a horizontal postion at least fifteen minutes or longer, if necessary, until the pulse rate was either the same or had not changed more than one or two beats in the count for three consecutive half minutes. Reclining pulse rate and blood pressure measurements were then made and recorded. At least three blood pressure measurements were made of each individual.

Five minutes were allowed before taking the pulse rates and blood pressure measurements between the change of positions from reclining to sitting and sitting to standing.

Pulse rates in the sitting position were read immediately after fifteen steps of exercise for one minute. The rhythm of the stool stepping was established by a metronome. The times were checked by a stop watch. Pulse rates were counted in one-half minute intervals for three minutes. If the pulse rate had not returned to normal or the same as the original sitting pulse rate within three minutes, the count was continued until the figures checked in three consecutive readings. A variation of a beat or two was disregarded.

A second stool-stepping exercise was the last of the series of cardiovascular tests made. The exercise consisted of thirty-five steps for one minute, and the pulse rates were determined as described above.

Because of a desire to check the consistency of the experimenter, correlations were computed between second and third measurements of each of the directly measured cardiovascular tests (but not between the derived scores). Every attempt was made to determine these measurements objectively and without regard to previous measurements

Reliability

Reclining pulse rate	.991	Standing systolic pressure	.989
Sitting pulse rate	.984	Reclining diastolic	.985
Standing pulse rate	.979	Sitting diastolic	.967
Reclining systolic pressure	.989	Standing diastolic	.960
Sitting systolic pressure	.977		

This of course does not correspond to reliability of scores but is a measure of the consistency of the observer in determining the scores. If there were errors they were consistent ones which would not affect correlations.

Determinations or reliability in the commonly accepted sense of the word were not attempted. Differences in physiological condition frequently produce changes in readings of cardiovascular variables from one day to the next. Though on each day at approximately the same time of day the *interrelationships* of all the variables may be quite consistent.

Multiple Factor Analysis.—The Pearson product-moment correla-

tions were obtained for each test against each of the other tests.* These correlations were used as the foundation for the correlation matrix which became the data sheet for calculating the first factor loadings.

Twelve factors were obtained from the correlation matrix by the use of Thurston's simplified factor method. These unrotated factor loadings form the factorial matrix.*

The next step was to attempt to identify these factors by rotation of this factorial matrix. The factors were rotated two at a time by the method of successive approximations. Traits were plotted in two dimensions.

In this study "logically fitted planes" were used to describe the factors. A study of the factors was made in a systematic manner and axes were rotated through clusters of traits that tended to group themselves in logical constellations. This process was continued until the diminishing returns from the rotations of each factor showed that no further improvement could be expected to come from further rotations. The final values obtained for the rotated factor loadings represented the zero-order correlations of each variable with each factor. Twenty-three sets of rotations, involving sixty-three different two-factor rotations were needed to rotate the factors found in this study.

Partial and Multiple Correlations.—Professor Thurstone holds that each of these factor loadings is comparable to a zero-order correlation with a common factor. So the factor loadings obtained from the final rotations of the factorial matrix were used as zero-order correlations of each test variable with each of the common factors. Partial and multiple correlations were computed, using the Doolittle method, to determine combinations of variables which would give the highest multiple correlations with the criteria. Regression equations were computed for combinations recommended for diagnostic and research purposes.

RESULTS

Multiple Factor Analysis.—The final rotations of the factorial matrix are given in Table I of this study. The column labeled "hypotenuse" (the square root of the communality) indicates the relative distance the trait is away from the origin when the factors are located in nine dimensions of space and represents the multiple correlation of each variable with all nine of the factors. The square of this number (the communality) represents the amount of the trait represented by common elements. The difference between this number and one is the amount accounted for by specific elements and by error.[53]

Identification of Factors.—Nine factors were isolated, five were satisfactorily identified, and four probably not entirely satisfactorily identified so far as the naming of the factors is concerned.

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* The intercorrelations and unrotated loadings will be sent by the author upon request.

Three of the factors were concerned with heart rates and six were associated with changes in blood pressure. In the identification of a factor, the variables which correlate highly with it are carefully examined for evidence of something in common—in this study, for some functional mechanism which would change all the variables concerned in the directions indicated by their signs. Due consideration is given to the factor loadings of these variables with other factors. An attempt is made to formulate an adequate hypothesis to explain this common function and to attach a satisfactory identifying name or descriptive phrase to the factor.

Factors Regulating Heart Rates.—

Factor I. This factor is most heavily loaded (see Table I) in reclining and sitting posture pulse rates, and the rates taken in a sitting position, one, two, and three minutes after mild exercise of fifteen steps. This factor may be called a *mechanism governing rates of the heart beat.*

Factor II. This factor represents the *compensation mechanism that controls the return of pulse rates to normal after strenuous exercise.* Heavy loadings are found in the variables representing the decrease in heart rates one, two, and three minutes after exercise, as well as the variables derived by subtracting the decreased rates one and two minutes after thirty-five steps from the pulse rate immediately after the same exercise. The factor loadings of the standing diastolic pressure, standing minus reclining and sitting minus reclining diastolic pressures, indicate a relationship of diastolic pressure to the pulse rate return to normal.

Factor III. This factor seems to represent the mechanism governing the increase in heart rate which occurs immediately upon the commencement of work. The only significantly heavy loading is found in variable 30, when pulse rates one minute after fifteen steps of exercise are subtracted from pulse rates immediately after exercise. This factor may be called, tentatively, the *emotional acceleration which accompanies muscular effort.*

Factors Regulating Blood Pressure.—

Factor IV. This factor seems to be a *general mechanism for governing minute volume* as heavy loadings are found in systolic pressures in sitting, standing, and reclining postures, diastolic pressure in standing and pulse pressures in sitting, standing, and reclining postures.

Factor V. This factor is most heavily loaded in the standing and sitting diastolic pressures with a negative, heavy correlation in standing heart rate after the reclining rate is subtracted. This factor seems to represent the *mechanism controlling vasomotor tone of the vascular system.*

Factors VI, VII, VIII, and IX. These are concerned with the hydrostatic pressure. Factor VI seems to be concerned with the splanchnic

TABLE I

ROTATED FACTOR LOADINGS

	I	II	III	IV	V	VI	VII	VIII	IX	Hyp.
1. Rec. P.R.*	.9068	—.0512	.0112	.2070	.0127	—.0538	—.0238	.0218	—.0396	.9346
2. Sit. P.R.	.8891	—.0971	.0745	.1018	—.1913	—.0157	—.0227	.0656	.0120	.9261
3. Std. P.R.	.6637	.1076	.0324	.0690	—.0003	.0349	.2031	.1560	.1832	.7472
4. Rec. S.P.	.3251	—.0101	.1609	.6362	.2922	.2182	.4711	—.3248	.1700	1.0128
5. Sit. S.P.	.2858	.0776	—.0128	.8448	.3606	.0534	.0384	—.0149	—.0068	.9674
6. Std. S.P.	.1315	.0084	.0313	.8364	.2434	.4323	.0569	—.0120	.0059	.9835
7. Rec. D.P.	.2179	—.0466	—.0028	.0620	.8396	—.0288	.3529	—.2318	.0843	.9717
8. Sit. D.P.	.0705	.1468	—.2037	.1042	.8275	.1359	.0673	—.0181	—.2560	.9233
9. Std. D.P.	—.0039	.5327	—.2710	.6339	.1755	.0047	.0387	—.1807	—.0353	.9085
10. Rec. P.P.	.1160	.1661	.0665	.6607	.4060	—.0100	.1218	.1907	—.0717	.8386
11. Sit. P.P.	.2213	—.0660	.2648	.6986	—.2952	—.0315	.0257	.1085	.0391	.8448
12. Std. P.P.	.0331	—.0646	—.0557	.5490	—.0155	.0192	—.4551	—.1596	.3412	.8120
13. P.R. immed. after 15 steps ex.	.6747	.2365	.2682	.1662	.0573	—.1549	.0760	.1380	.1212	.8231
14. P.R. one min. after 15 steps ex.	.8188	.3636	.1361	.0557	.0738	—.0760	—.0800	—.2252	—.0197	.9450
15. P.R. two min. after 15 steps ex.	.8817	.0026	—.1541	.1123	—.0404	.2063	.0210	.1536	.0004	.9392
16. P.R. three min. after 15 steps ex.	.9002	.0007	—.1112	.1136	—.0269	.1351	.1024	.1827	.0723	.9507
17. P.R. immed. after 35 steps ex.	.1575	.2026	.2397	.0797	.0201	—.0823	—.0094	.0576	.5151	.6368
18. P.R. one min. after 35 steps ex.	.4954	.6406	.1034	.0962	—.0669	—.0241	—.0004	—.2143	.2637	.8923
19. P.R. two min. after 35 steps ex.	.7065	.4890	.1278	.1558	—.0602	.1018	—.0330	—.3403	—.0799	.9571
20. P.R. three min. after 35 steps ex.	.6929	.5450	.0874	.0966	.0136	.0901	.0812	.1749	.0109	.9164
21. Std. P.R. minus R.P.R.	—.5201	—.0123	.1102	—.0003	—.6747	.0712	.1065	—.1664	.0802	.8880
22. Std. P.R. minus Sit. P.R.	—.3791	.0825	—.0323	.1070	—.0373	.0705	.4658	.1305	—.1063	.6439
23. Sit. P.R. minus R.P.R.	.2739	.1430	.1188	—.2126	—.0307	—.2615	—.1314	.7043	.1520	.8720
24. Std. S.P. minus R.S.P.	—.2293	.0182	.0066	.0402	.1235	.7730	—.4734	.0441	.0944	.9499
25. Std. S.P. minus Sit. S.P.	.2096	.1827	—.1687	—.0496	.0187	.6497	—.0054	—.0738	.5180	.8969
26. Sit. Sys. P. minus R. Sys. P.	—.0629	—.1266	.2631	.1332	.0386	.2658	—.6837	.0548	—.3995	.9995
27. Std. D.P. minus Rec. D.P.	—.1186	.3219	—.1918	.2471	—.2965	.5879	.0776	.3952	—.1601	.9148
28. Std. D.P. minus Sit. D.P.	.1142	.1159	.2431	.1466	—.2931	.5801	.4584	.1920	.0594	.8832
29. Sit. D.P. minus R.D.P.	—.1850	.3081	—.0405	—.2226	—.1519	.4864	—.0276	.2968	—.3993	.8296
30. P.R. immed. after 15 steps minus P.R. one min. after ex.	—.4927	.1710	.5376	.0546	.0357	—.2687	.0197	.0085	.2453	.8355
31. P.R. immed. after 35 steps ex. minus P.R. one min. after ex.	—.4011	—.6331	.1501	.0173	.0825	—.0090	—.0701	.1781	.2737	.8355
32. P.R. immed. after 35 steps ex. minus P.R. two min. after ex.	—.5312	—.6053	.1727	.1246	—.1363	—.2456	.0454	.2778	.0966	.9281

* The abbreviations may be interpreted as follows: Rec., reclining; P.R., pulse rate; P.P., pulse pressure; Sit., sitting; Std., standing; D., diastolic; Sys., systolic.

accommodation to changes of hydrostatic pressure due to change of position, and factors VII, VIII, and IX are concerned with hydrostatic pressures due to redistribution mechanisms. These factors are probably not entirely satisfactorily identified so far as the naming of the factors is concerned. It was thought, however, to be the wiser plan to attempt a tentative identification rather than to name them simply hydrostatic factors A. B, C, and D, which would be no aid to other students of this problem.

Factor VI. This factor seems to be a *mechanism governing the general splanchnic accommodation to changes of hydrostatic pressure due to changes of position.* It is most significantly loaded in standing systolic pressures minus the reclining and sitting systolic pressures as well as consistently heavy loadings in the standing diastolic pressures minus the reclining diastolic and sitting diastolic pressures and the sitting diastolic pressure minus the reclining diastolic pressure.

Factor VII. This factor is tentatively identified as a *redistribution mechanism of the blood upon change of position,* probably due to general tonus changes of the splanchnic circulation. The positive loadings in the reclining systolic and diastolic pressures, and the negative factor loading in the standing pulse pressures is consistent with the findings obtained in the derived measures.

Factor VIII. This factor seems to represent the *redistribution mechanism governing splanchnic relaxation in response to the raising of the hydrostatic pressure during muscular inactivity.* The heaviest loadings are found in the sitting pulse rate minus the reclining rate, the standing diastolic minus the reclining diastolic pressures, and the negative loadings of the reclining systolic pressure and pulse rate two minutes after thirty-five steps. This identification is a very tentative one, and is not strongly buttressed by supporting evidence.

Factor IX. This factor is tentatively identified as a *redistribution mechanism responding to changes in hydrostatic pressure in response to changes of position.* (The specific nature is unknown.) It is most heavily loaded in standing systolic minus sitting systolic pressure, pulse rate immediately after thirty-five steps exercise, the sitting systolic minus reclining systolic pressure, the sitting diastolic minus the reclining diastolic and standing pulse pressure. The small number of variables involved and the relatively low factor loadings make a more specific identification difficult.

Multiple Correlations and Regression Equations.—One of the chief problems in validating tests is to establish a criterion. It has been found that the common and group factors which emerge from Thurstone's method of analysis are valid measures of primary components and the regression weightings for combinations which give high multiple correlation with these factors are satisfactory for giving accurate estimates of such criterion factors.[61, p. 73]

* The abbreviations may be interpreted as follows: Rec., reclining; P.R., pulse rate; P.P., pulse pressure; Sit., sitting; Std., standing; D., diastolic; Sys., systolic.

Factor I. The multiple correlation of Factor I, a mechanism governing rates of the heart, with reclining pulse rate and sitting pulse rate, was found to be .9336. The regression equation* for the two-variable battery is:

$$\widetilde{X}_1 = .4907X_1 + .4728X_2 - 28.34.$$

Factor II. The multiple correlation of three tests in factor II, the mechanism governing the return of pulse rate to normal after strenuous exercise, or the compensation factor, was found to be .8773 and a battery of two tests was found to be .8770. The regression equations for the two and three variable batteries are:

$$\widetilde{X}_2 = .2049_{18} + .0688_{32} + 29.8994$$

$$\widetilde{X}_2 = .3390X_{18} - .8790X_{32} + .3673X_{31} + 40.46$$

Factor III. In factor III there was only one factor loading of importance. Multiple correlations and regression equations were not calculated. The factor loading is not high enough to justify using it for predictive purposes.

Factor IV. The multiple correlation of factor IV governing minute volume with standing systolic pressure and sitting pulse pressure was found to be .9135 and with the addition of sitting systolic pressure the multiple correlation becomes .9349. The regression equation for the three and two variable batteries are:

$$\widetilde{X}_4 = .2374X_6 + .2280X_{11} + .6854X_5 - 55.55$$

$$\widetilde{X}_4 = .6303X_6 + .4483X_{11} + 24.30$$

Factor V. The general mechanism controlling the tone of the vasomotor system is indicated by the high loadings of .8396 and .8275 in the reclining and sitting diastolic pressures. The regression equation of the battery for estimating vascular tone is:

$$\widetilde{X}_5 = .6067X_8 + .5603X_7 - 29.6586$$

Factor VI. A multiple correlation of four vascular tests with the mechanism governing the splanchnic accommodation to changes of hydrostatic pressure due to changes of position is .9085. A two-variable battery of standing systolic pressure minus reclining systolic pressure and standing diastolic pressure minus sitting diastolic pressure gives the same correlation, .9085, as the four-variable battery. The regression equation for predictive purposes is:

$$\widetilde{X}_6 = .9169X_{24} + .6667X_{28} - 47.2013$$

* In computing these multiple regressions, the mean of the factor was taken as 50 and the standard deviation as 10. The result is in terms of T-scores. The test numbers correspond to those in Table I.

Factor VII. A multiple correlation of four vascular tests in factor VII which is tentatively identified as a redistribution mechanism of the blood upon change of position due to general tonus change of the splanchnic circulation, was found to be .7862. The factor loadings are not large, ranging from .3529 to —.4734, but are consistent in size. The regression equation is:

$$\widetilde{X}_7 = .1621X_{24} - .3913X_7 - 1.0683X_{12} + 1.1935X_4 - 23.46$$

Factor VIII, which is tentatively identified as a redistribution mechanism governing splanchnic relaxation in response to raising of the hydrostatic pressure during muscular inactivity, has a two-variable battery multiple correlation of .7988.

The regression equation for estimating splanchnic relaxation in response to raising of the hydrostatic pressure during muscular inactivity is:

$$\widetilde{X}_8 = 1.1983X_{23} + .4368X_{27} + 39.4115$$

Factor IX, which is tentatively identified as a redistribution mechanism responding to changes in hydrostatic pressure in response to changes of position, has a three-variable battery multiple correlation of .5842 and a two-variable battery of .5605. These multiple correlations are not high enough to warrant calculation of regression equations for prediction.

SUMMARY

In this study a factor analysis of thirty-two tests of the cardiovascular system was made.

Nine factors were analyzed and tentatively identified in terms of the variables affected. Three of these variables are concerned with the regulation of heart rates, two with the mechanisms governing blood pressures, one with the hydrostatic pressure, and three with the redistribution mechanism of the blood related to changes in the hydrostatic pressure. Factors I, II, and III are concerned with heart rates. Factors IV and V are concerned with blood pressures, factor VI with the mechanism of hydrostatic pressure, and factors VII, VIII, and IX with redistribution mechanisms of the blood related to changes in the hydrostatic pressure.

The major contribution of this part of the study lies in the fact that it seems to have been shown that the cardiovascular functions are divided into a number of quite different primary factors. The factors have been tentatively identified as mechanisms governing: (1) rates of the heart, (2) compensation or return of pulse rates to normal after strenuous exercise, (3) the emotional acceleration which accompanies muscular effort, (4) minute volume, (5) vasomotor tone of the vascular system, (6) splanchnic accommodation to changes of hydrostatic pressure due to changes of position, (7) redistribution of the blood upon

change of position due to general tonus changes of the splanchnic circulation, (8) redistribution of blood in splanchnic relaxation in response to raising of the hydrostatic pressure during muscular inactivity, and (9) a redistribution mechanism responding to changes in hydrostatic pressure in response to changes of position (specific nature unknown).

Combinations of variables were set up for each factor and multiple correlations and regression equations were calculated by which these functional factors may be measured to a reasonably high degree of accuracy. The findings should point the way toward simpler and more efficient cardiovascular testing in the future, largely through isolating and more accurately measuring specific aspects of the cardiovascular mechanisms.

This study may be considered as one exploratory study into this field, the results of which should lead to further investigations. The findings here may help in the planning and organization of other studies.

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A Comparative Study of Undergraduate Men Majors and Non-Majors in Physical Education with Respect to Certain Characteristics

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THE PROBLEM

FOR many years there has been a difference of opinion as to how students enrolled in various colleges and schools within universities compare with respect to such traits as health, size, socio-economic status, recreational interests, physical capacity, and a host of other traits or qualities that are comparable. This difference of opinion has been discussed many times by friends, faculty, and students of West Virginia University. To date, there have been no studies made on this campus to support the contentions of any group.

The value of such a study is great, since guidance and planning become more effective when the abilities and traits of a group are known and understood. Quite often an adviser hesitates to suggest to students certain studies to pursue, because he does not have sufficient evidence of the students' characteristics to justify his decision. Information of this type should be available to each adviser of students in order to get the best results.

It was the purpose of this study to show the similarities and differences between undergraduate men enrolled in the School of Physical Education and Athletics and those in the College of Arts and Sciences and the College of Engineering and Mechanic Arts at West Virginia University during the academic year, 1938–1939. The factors measured in this study were (1) socio-economic status, (2) recreational interests, (3) health status, and (4) scores on the Physical Achievement Test of the Department of Service Program for Men.

SOURCE OF DATA

The information used in this report came from three sources, (1) a questionnaire,[1] (2) health records, and (3) physical achievement test records. The questionnaire included questions relating to both socio-economic status and the student's recreational interests. The reliability

This article is an abstract of a master's thesis at West Virginia University, 1939.

[1] The questionnaire was also used in a parallel and concurrent study by A. Elizabeth Marshall on West Virginia University Women. Miss Marshall compared Physical Education, Arts and Sciences, and Home Economics Women.

of the questionnaire was found by issuing to the subjects a second questionnaire six weeks after the first one and comparing the agreement between the two. The percentage of agreement was found to be 90 to 100 in most cases. The questions having lower agreement than mentioned above concerned parents' income, magazines read regularly, and activities in which they had participated. These agreements were 80, 65, and 68 per cent, respectively.

QUESTIONNAIRE

Date..... No.....

Indicate the proper response by a check (V)

1. I am a freshman ( ), sophomore ( ), junior ( ), senior ( ).
2. Now enrolled in the College of: Home Economics ( ), Arts and Sciences ( ), Engineering and Mechanic Arts ( ), Physical Education and Athletics ( ).
3. If you attended college last year, how much did it cost you? $.....
4. How much do you anticipate it will cost you to attend college this year? $.....
5. How much of this cost will be the result of your own earnings? All ( ), ¾ ( ), ½ ( ), ¼ ( ), None ( ).
6. Who contributes the money which you have not earned? .....
7. Do you have an N.Y.A. job? Yes ( ), No ( )
8. Some other part-time job? Yes ( ), No ( )
9. Where do you live? Dormitory ( ), fraternity house ( ), at home ( ), with relatives ( ), apartment ( ), private home other than relatives ( ).
10. Parents' or guardians' present occupation? .....
11. What was your parents' income during the past 12 months? Under $500 ( ), $500–1,000 ( ), $1,000–2,000 ( ), $2,000–3,500 ( ), $3,500–5,000 ( ), $5,000–10,000 ( ), over $10,000 ( ).
12. Number of (living and dead): brothers ...., sisters ...., half-brothers ...., half-sisters. .....
13. Is there a radio in your parents' home? Yes ( ), No ( ).
14. Is there an electric refrigerator in your parents' home? Yes ( ), No ( ).
15. Is there a telephone in your parents' home? Yes ( ), No ( ).
16. How many books are there in your parents' home? Under 50 ( ), 50–100 ( ), 100–500 ( ), 500–1,000 ( ), 1,000–5,000 ( ), over 5,000 ( ).
17. Check and list magazines read *regularly* in your home: American Magazine ( ), Arts and Crafts ( ), Atlantic Monthly ( ), Colliers ( ), Cosmopolitan ( ), Detective Magazine ( ), Good Housekeeping ( ), Harpers' Bazaar ( ), Hygiea ( ), Ladies Home Journal ( ), Liberty ( ), Life ( ), McCalls ( ), National Geographic ( ), New Republic ( ), Pictorial Review ( ), Popular Mechanics ( ), Reader's Diges), Red Book ( ), Saturday Evening Post ( ), Time ( ), Vogue ( ), Western Magazine ( ), Woman's Home Companion ( ), others .....
18. Check or list the *five* types of activities in which you participate most: bowling ( ), golf ( ), handball ( ), swimming ( ), tennis ( ), bridge ( ), checkers ( ), chess ( ), poker ( ), solitaire ( ), nature study ( ), collecting stamps ( ), playing musical instruments ( ), art galleries ( ), museums ( ), puzzles ( ), reading ( ), fiction books ( ), hiking ( ), singing ( ), visiting ( ), listening to radio ( ), dancing ( ), movies ( ), riding ( ), fishing ( ), camping ( ), others .....

The information concerning the subject's health was obtained from the record cards in the office of the Student Health Service. The criteria

used in this study for determining the health status of the men were the condition of: (1) teeth, (2) distance vision, (3) tonsils, (4) heart, (5) lungs, (6) ears, and (7) whether or not they had any old physical deformities. The height and weight records were also used in order to compare the students in each of these measurements.

The physical achievement test is given to freshmen while in the regular service program classes. This test includes (1) high jump, (2) bar vault, (3) rope climb for time, (4) 176-yard run, and (5) baseball throw for accuracy. Scores on this test are based on a modified T-score. The passing score for the second semester, 1938–1939, was a total of 125 points with at least 20 points in each event.

SUBJECTS

Since the main object of this study was to get a true picture of the traits or qualities of undergraduate men in physical education, all physical education men who were not transfer students from other universities were used in this survey. They were compared with a random sampling of men enrolled in the College of Arts and Sciences and the College of Engineering and Mechanic Arts. The random sampling comprised 12 per cent of the total male enrollment of these two colleges. These colleges were chosen because one is professional and one is non-professional and because they, too, accept freshmen, sophomores, juniors, and seniors, while some of the other schools and colleges do not.

The total number of subjects used included 60 physical education men, 100 arts and sciences men, and 54 engineering men. The reason for using a random sampling for the two colleges was that to include all students in these colleges would be more extensive than time permitted. The subjects were full-time[2] students at West Virginia University during the academic year 1938–1939.

SUMMARY OF FINDINGS

Socio-Economic Status.—Since the parental income is a great factor in the upkeep of the home, the students were asked to report the amount of money earned by their parents during the past twelve months. On this item there may have been some motive for giving incorrect responses. The reliability of this item was +1.00. Fifty-one per cent of the physical education men came from families earning less than $1000, while only 24.5 per cent of the engineering men and 20.8 per cent of the arts and sciences men had parents in this classification. In the group earning over $3500, more parents of arts and sciences were found, with the parents of engineering men ranking second.

It was thought that information on the types of occupations in which the parents engaged might throw some light on the home condi-

[2] A full-time student is one who carries ten or more hours each semester.

tions. The Sims Scale of occupational groups were used.[3] This scale divides all occupations into:

Group I. Professional men, proprietors of large businesses, and higher executives.

Group II. Commercial service, clerical service, large land owners, managerial service of a lower order than in Group I, and business proprietors employing from five to ten men.

Group III. Artisan proprietors, petty officials, printing trades employees, skilled laborers with some managerial responsibility, show owners, and business proprietors employing one to five men.

Group IV. Skilled laborers (with exception of printers) who work for someone else, building trades, transportation trades, manufacturing trades involving skilled labor, personal service, and small shop owners doing their own work.

Group V. Unskilled laborers, common laborers, helpers ("hands"), peddlers, varied employment, venders, and unemployed (unless it represents the leisured class or retired).

Only 10.8 per cent of the physical education men were found in the upper two groupings of occupational classification, while 45.1 per cent of the arts and sciences men and 36.7 per cent of the parents of engineering men were found here. The opposite was true of Groups IV and V, where 66 per cent of the parents of physical education men, 22.1 per cent of the parents of arts and sciences men, and 26.5 per cent of the parents of engineering men were found.

Quite often it has been said that college students come from small families instead of large ones. This was not the case among the male students studied here. It was found that the average size of the families from which physical education men came was 5.23 ± 2.43, for arts and sciences men 4.11 ± 2.15, and for engineering men, 4.13 ± 1.77. These family groups were larger than the national average for the United States in 1930, which was 3.40 persons per family.

The questionnaire also reported the presence of a radio, telephone, or electrical refrigerator in the homes of the students. It was found that practically every home, in all three groups, had a radio while the presence of a telephone or electric refrigerator was not so common. Telephones were found in homes of 40 per cent of the physical education men, 90 per cent of the arts and sciences men, and 72 per cent of the engineering men. Electric refrigerators were found in 41.6 per cent of the homes of physical education men, 84 per cent of the arts and sciences men, and 79.6 per cent of the engineering men. It may be that some of the men answered this last question positively when they did not have one in the home. They may have been thinking of mechanical refrigerators, which would include gas refrigerators.

To continue the comparison of socio-economic status of these homes, it was found that 50 per cent of the homes represented by physical

[3] V. M. Sims, *The Measurement of Socio-Economic Status.* (Bloomington, Illinois: Public School Publishing Company, 1928) p. 22.

education men had less than one hundred books, while the same number was found in only 33 per cent of the homes represented by arts and sciences students and 37.1 per cent of the homes represented by engineering men.

It was surprising to find that no physical education men were living in the Mens' Dormitory. This was not true of the other groups. Twenty-one per cent of the arts and sciences men and 33.4 per cent of the engineering men lived here. Also fewer physical education men lived in fraternities than did the other groups of men. Many men from all three groups were able to live at home and attend college.

The questions relating to the amount of money necessary for college education showed that those students living away from home while attending college spent approximately $300 more yearly than do those men living at home. The physical education men living at home state that they spend on an average of $269.05, while the arts and sciences men and engineering men spend on an average of $284.62 and $290.00, respectively.

From the facts just presented it was desired to learn further where the money came from that made it possible for these men to attend the University. It was found that 55 per cent of the physical education men were earning three-fourths or more of their total expenses while attending college. This was true of only 21 per cent of the arts and sciences men and 16.7 per cent of the engineering men. At this point the question should probably be raised asking how students, who earn all of their college expenses, can find ample time to do the same amount of college work required of other students who earn no part of their college expenses. Certainly the working student should, in most cases, carry less college work and probably finish school in five academic years instead of the usual period of four academic years.

It was also shown that 41 per cent of the arts and sciences men and 37 per cent of the engineering men do no outside work while attending college. The same is true for only 13.3 per cent of the physical education men. Those students who did not earn all of their expenses usually secured the remainder from their parents. It should be pointed out that 20.5 per cent of the physical education men received help from individuals other than parents or relatives, while this was true for only 5.9 per cent of the arts and sciences men and 6.2 per cent of the engineering men. This is probably due to the fact that several of the physical education men are in college on scholarships.

Recreational Interests.—The subjects were asked to list the magazines read regularly in their homes and to state their choice of five recreational activities engaged in during the past year. No difference was found in their selection of magazines. Each group chose *Collier's Magazine* as their favorite magazine. Other magazines ranking high in all three groups were *Liberty, American Magazine, Good House-*

keeping, Saturday Evening Post, Reader's Digest, Life, Cosmopolitan, and *Ladies Home Journal.*

A slight difference was found in the activities chosen by these men. The first four recreational activities for each group were identical, with the rank being slightly different. These four were swimming, dancing, listening to the radio, and attending movies. The next seven ranking activities indicated that the physical education group selected those activities which require much activity such as football, basketball, and baseball, while the other groups selected less strenuous recreation such as reading fiction, playing bridge, and golf. Also, the physical education group was the only one to indicate participation in team games.

Health Status.—It is not known exactly what constitutes good health, but ratings were set up in this study to classify students in relation to health. The criteria used for this survey included condition of teeth, distance vision, tonsils, ears, heart, lungs, and old deformities. Height and weight were also studied to see if differences existed in these anthropometric measurements. Very little difference was found between the three groups of men in respect to incidence of defective teeth, defective distance vision, or defective ears. More physical education men had defective tonsils than did members of the other groups. This is probably due to the lower economic level of families from which these men came. When the incidence of defective hearts and lungs were checked it was seen that not a single physical education major was in this classification. Although the percentage was low for the other groups it should not be overlooked that the three criteria last mentioned would definitely keep individuals out of an active occupation.

In regard to the mean height of the subjects, no statistically significant difference was found among the three groups. The arts and sciences men were on an average 0.01 and 0.37 inches taller than the engineering men and physical education men, respectively.

In regard to the mean weight of the subjects the physical education men were on an average sixteen pounds heavier than men in the other two colleges. This difference was statistically significant.

Physical Achievement Test Records.—At West Virginia University all freshmen, unless excused, are required to take Physical Education 1 and 2. These classes are the regular service program classes which include participation in such activities as speedball, football, basketball, handball, tennis, volleyball, softball, and the like. While in Physical Education 1 and 2, the students are given the West Virginia University Physical Achievement Test. Those who pass this test are placed in the elective group. This group of men does not come to the regular class but go to the Field House at their convenience, twice weekly, for an hour of participation each time.

Occasionally the Health Service physician recommends that a student not participate in the regular class because of some handicap such as heart trouble, defective feet, or some similar defect. These men are placed in the restrictive group. They play quieter types of games such as table tennis and shuffleboard for two hours weekly at their convenience.

When scores on this test were tabulated for the subjects of this study it was found that the physical education men excelled the other groups. Their mean score was 131.3 ± 9.85 while the engineering men ranked second with a mean score of 103.54 ± 11.05 and the arts and sciences men third with a mean score of 87.78 ± 8.37. The differences were statistically significant.

It was also of interest to note that no physical education men were placed in the restrictive group, while five arts and sciences and two engineering men were found here. This seems to indicate that men in the restricted group are not adapted for the physical education profession.

CONCLUSIONS AND RECOMMENDATIONS

From the findings presented it is evident that many students are in college only because they can work while in attendance or live at home while attending. Since many of the fathers worked in lower economic occupations, the students had to work their way through college. Also, the larger the family, usually, the lower the economic level of the home. Since many of the homes had fewer than one-hundred books, it would seem logical to say that a great many homes from which university students come must depend largely upon public libraries for much of their reading material. Contrary to the common saying, no "pulp" magazines were found in the first fifteen magazines listed as read regularly in the home. For recreation all groups chose both active and inactive pastimes. Since the physical education men are normally engaged in more of this activity work than the other groups, it was not surprising to find them often choosing a more strenuous type of activity. Because the physical education major must be physically fit to pursue his occupation, it also was not surprising to find him ranking slightly higher than the other subjects. He was also much heavier than the other subjects. Another factor worth noting is that no physical education men were placed in the restricted classes while this was not true for the other groups. All of this adds up to the fact that the physical education major at West Virginia university usually comes from a lower socio-economic level home than other students, he has fewer home conveniences than other students, although he usually has a radio, he must work his way through college in part, he has more brothers and sisters than other men, he has less than fifty books in the home, he desires both active and inactive recreation, he enjoys team games, reads

Collier's Magazine, he is healthier and heavier than other students, and he excels in physical achievement.

On the basis of the information presented above, the following recommendations are made:

1. A complete record of each student, including his home conditions and work outside of college classes, should be in the office of his adviser so that the student can be better advised as to the amount and kind of college work he should carry.

2. Students who do not live at home or with relatives, who attempt to earn one-half or more of their college expenses, should carry a smaller amount of college work. This is suggested since earning this amount of money would require their being away from the campus much of the time. This would necessitate spending an additional academic year in order to complete work on a baccalaureate degree.

3. There should be more public libraries for the use of parents and students.

4. Physical education freshmen should be advised to live in the dormitory since valuable training and social experience are received there. The association with other men will probably be of considerable value to them in their later professional and community work.

5. The university should provide additional facilities for swimming, tennis, handball, and bowling, so that all university men could participate in these activities while in college. There should also be facilities for camping, hiking, fishing, and the like, since several students reported a desire for these activities.

6. A study similar to this one should be made within the next five years to see if conditions at that time are similar to those reported in this survey. It is also suggested that more time be spent in making the next survey so that all students could be included instead of a sampling, as used in this report.

The Evaluation of Boxing as a College Activity

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INTRODUCTION

BOXING as a sport to be promoted in educational institutions has been lauded by some and severely attacked by others. There are those who believe firmly that boxing is a worth-while activity and that it should be promoted in the sports program on a par with activities such as football, basketball, wrestling, etc. There are a great many others, however, just as experienced in the field of physical education, who are firmly convinced that boxing is dangerous, fosters bad spirit, and in many other respects is not desirable in an educational system.

The main argument by those opposed to boxing seems to be that the sport is dangerous to the mental well-being of those participating. Those in favor of boxing point to studies of athletic injuries which rank boxing as not so hazardous as many other sports which are not subject to the same degree of criticism. Studies by Lloyd, Deaver, and Eastwood[1]* of New York University place boxing seventh as far as risk is concerned.

Those who criticise boxing, however, are not so much concerned with the number of injuries as with the type and severity of those which do occur. They speak of cumulative damage to mental processes caused by many concussions of varying severity. The sport has been attacked on the grounds that the offensive skill of a boxer is judged by his demonstrated ability to cause concussion. In other words, it is claimed that the objective of boxing is to injure an opponent.

This study was made in an attempt to discover whether or not boxing in schools and colleges should be encouraged or discouraged. An attempt was made to consider fairly both sides of the question.

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* Numbers refer to Bibliography at end of article.

PROCEDURE

The procedure followed in this investigation was used in order that the statistics would thoroughly cover the boxing problem from the standpoint of its advantages and disadvantages. Questionnaires were sent to the outstanding neurologists and psychiatrists, since it is plausible that at least some of the injured cases, if any, would be referred to these specialists. The opinion of such physicians, who are authorities in the field of nervous and mental diseases, on whether or not boxing is a dangerous sport activity (to the central nervous system), must certainly be considered seriously.

The pathologists and coroners of the larger towns, under whose jurisdiction inquests and autopsies are performed were sent the following questionnaires:

Pathologist's and Coroner's Report

1. Have you examined any person whose death has been attributed directly or indirectly to boxing? How many?
2. What were the important autopsy findings?
3. Important related history and clinical record of patients.
4. What was the greatest number of cases observed in one year?
5. From the standpoint of the student's welfare, do you think it is advisable to include boxing as an intramural, physical education, or intercollegiate sport? Why?
6. Any further information that you can give us will be deeply appreciated.

Questionnaire Sent to Neuropsychiatrists and Neurosurgeons

1. Have you had any cases with physical or mental impairment that were directly traceable to participation in boxing?
2. What were the clinical manifestations? Immediate and remote effects?
3. What was the time duration of the ill effects?
4. Have you had any cases of amnesia? How many?
5. Have you had any deaths due to boxing? How many?
6. If an autopsy was done, please give the important pathological findings.
7. How many years does your observation cover?
8. What was the greatest number of such injuries observed in one year?
9. Do you feel that boxing is a hygienic activity for boys of college age? Why?
10. Can repeated blows on the head over a period of two to four years cause a gradual change in mental patterns, personality, etc., of the individual?
11. Any further information you can give us will be deeply appreciated.

The athletic directors of the larger colleges and universities in the United States were also contacted. At a later date, the directors of the health service of these institutions were questioned. The athletic directors and directors of health service responded to the following questionnaires respectively:

Athletic Directors

1. Does the athletic department of your institution sponsor varsity boxing?
2. Is boxing an intramural activity at your institution?
3. Is boxing taught in the sports or physical education curriculum?
4. If boxing is not sponsored as a varsity sport, what are the reasons for not including boxing?
5. How many boys are out for the boxing team each season?
6. How many participate yearly in your intramural boxing tournament?
7. How many boys take class work in boxing each year?
8. Have you noticed any cases of so-called "punch drunk" boxers on the squad? How many each year?
9. Underline any of the following conditions which have been observed among your boxers: disturbance of equilibrium; deterioration of concentration, attention, memory; impediment of speech; gait unsteady; headaches; dizziness; mental and personality changes; vacant look in eyes; others.
10. Do you feel that boxing is a suitable activity for college intercollegiate competition? Intramural? Why?
11. Do you think boxing should be taught as a class activity in physical education? Why?
12. Any further information you can give us will be deeply appreciated.

Director of Health Service

1. Does the athletic department of your institution sponsor varsity boxing?
2. Is boxing an intramural activity at your institution?
3. Is boxing taught in the sports or physical education curriculum?
4. If boxing is not sponsored as a varsity sport, what are the reasons for not including boxing?
5. Have you noticed any cases of physical or mental impairment that were directly traceable to participation in boxing?
6. What was the extent of the clinical manifestations? Immediate and remote effects?
7. What was the time duration of the ill effects?
8. Have you had any cases of amnesia? How many?
9. Have you had any deaths due to boxing? Was an autopsy performed? What were the findings?
10. Underline any of the following conditions which have been observed among your boxers: disturbance of equilibrium; deterioration of concentration, attention, memory; impediment of speech; unsteady gait; headache; dizziness; mental and personality changes; vacant look in eyes; others.
11. How many years does your observation cover?
12. What was the greatest number of such injuries observed in one year?
13. Do you feel that boxing is a hygienic activity for boys of college age? Why?
14. Do you feel boxing is an appropriate sport for high school boys?
15. Do you require a physical examination of students in intercollegiate sports? Intramural sports?
16. Any further information you can give us will be deeply appreciated.

The neurologists, psychiatrists, coroners, pathologists, athletic directors, and health service directors have responded splendidly, and we wish to thank them for their cooperation in making this investigation possible.

THE RESULTS

The data obtained from the questionnaires used in this study have been correlated and show the following results.

TABLE I

BOXING IN COLLEGES AND UNIVERSITIES

	Intercollegiate Boxing		Intramurals		Required Physical Education	
	No.	Per Cent	No.	Per Cent	No.	Per Cent
Number of schools sponsoring boxing	32	38.1	55	65.4	66	78.5
Number of schools not sponsoring boxing	48	57.1	29	34.5	18	21.4
Number of schools in which boxing discontinued	4	4.7				
Total number of schools reporting	84		84		84	
Total number of students engaged in the sport	1760		5680		12350	

The survey shows as will be noted in Table I, that a considerable number of colleges and universities are sponsoring boxing in some phase of the physical education program. Of the 84 schools which reported, 66 or almost 80 per cent, offer boxing in their required instructional programs. Over 65 per cent have intramural boxing, and almost 40 per cent have intercollegiate boxing. The popularity of boxing among students is shown by the fact that almost 20,000 boys are participating in the 84 institutions contacted.

TABLE II

OPINIONS OF THE ATHLETIC DIRECTORS IN REGARD TO BOXING

	Yes	Per Cent	Yes, with Reservations	Per Cent	No	Per Cent	Total Reporting
Should boxing be an intercollegiate sport?	14	21.5	18	27.8	33	50.7	65
Should boxing be an intramural sport?	29	44.6	21	32.3	15	23.	65
Should boxing be a class activity in physical education?	41	63.	17	26.1	7	10.7	65

Table II shows that slightly over half of the athletic directors who responded to the question of boxing in schools are not in favor of boxing as an intercollegiate sport. A few of the directors of athletics in schools where intercollegiate boxing is now sponsored reported that they were

not in favor of interschool boxing but added that in their institution there is an intense interest and alumni following and it is not so easy to remove a sport from the program once it has gained foothold.

Only about 23 per cent of athletic directors are against intramural boxing, however, with 44.6 per cent definitely in favor of boxing in intramurals.

TABLE III

OPINIONS OF HEALTH SERVICE DIRECTORS IN REGARD TO BOXING

	Yes	Per Cent	Yes, with Reservations	Per Cent	No	Per Cent	Doubtful	Per Cent	Total Replying
Do you feel boxing a hygienic activity for college students?	16	21.7	20	27	31	41	7	9.4	74
Do you think boxing an appropriate sport for high school boys?	9	14.5	11	17.7	36	58	6	9.6	62

The health service directors were asked if they felt boxing is a hygienic activity for college and high school students. No distinction was made here between intercollegiate, intramural, or physical education class boxing. In the case of boxing for college students, 41 per cent of the directors, as may be seen in Table III, answered "no" without reservation. For high school boys the percentage against boxing was much greater, or 58 per cent.

TABLE IV

1. Number of schools that have boxing as intercollegiate sport in which director of athletics does not believe it should be included	6
2. Number of schools that have boxing as intercollegiate sport in which director of health service does not believe it should be included	6
3. Number of schools that do not have boxing, but athletic director thinks it should be included	5

As shown by Table IV, six colleges and universities support intercollegiate boxing teams in spite of the fact that the health service and athletic directors do not believe the sport should be included. There are, however, five athletic directors in universities who believe boxing should be included in the program of sports even though it is not now included. It seems that the opinions of the six who now have boxing is of more worth to a study of this nature than the opinions of the five who are considering including boxing.

As shown by Table V, a little over half of the athletic directors announced that their main reason for sponsoring boxing is its value in *physical development* of those participating. All active sports properly conducted will undoubtedly be of some value in this respect. It would be quite difficult for an exponent of boxing to prove that boxing

TABLE V

REASONS WHY BOXING SHOULD BE OR IS INCLUDED IN VARSITY, INTRAMURAL, OR PHYSICAL EDUCATION SPORTS CURRICULUM

	No.	Per Cent
Physical development	23	53.4
Self-defense	19	44.1
Poise	8	18.6
Interest or popularity among student body	7	16.2
Confidence	6	13.9
Valuable exercise	6	13.9
Opportunity for all weights	5	11.6
Alertness	5	11.6
Courage	5	11.6
Self-control	4	9.3
Skill	4	9.3
Expression which cannot be satisfied in other sports (urge of combat, inherent desire to use fist)	4	9.3
Agility	3	7.0
Ability to take and receive	3	7.0
Sportsmanship	3	7.0
Initiative	2	4.6
Wholesome pleasurable sports	2	4.6
Character building	1	2.3
Respect for other fellow	1	2.3
Development of personality	1	2.3
"Carry-over" benefit	1	2.3
Brings out gentleman in man	1	2.3
Variety	1	2.3

has more to offer from the developmental angle than several other sports.

Another reason for promoting boxing—in fact, second in importance as shown by Table V—is *self-defense*. In other words, one objective of teaching boxing in colleges is to give the students skills which can be used as a means of self-defense. This objective merits analysis. Self-defense from what? The day is gone when we are called upon to defend our honor in this so-called "manly" fashion. From "stick up" men? What chance is there of attempting a straight right on a man whose index finger is twitching on the trigger of a gun?

Third in number of times mentioned by directors of athletics was the *development of poise*. This quality is difficult to measure, but undoubtedly all sports have value in this respect, especially if a boy does his share of the winning and learns how to lose gracefully. It is rather easy to see how a consistent winner in boxing may develop confidence and poise, but on the other hand a defeat of the manner dealt out in this sport is likely to be considerable of a setback in poise development.

Fourth in number of times mentioned was "interest and popularity among student body." Unquestionably boxing is very popular among college boys. Nearly every active boy is interested in watching contests and in learning some of the skills. This is probably one of the best arguments in favor of boxing in a program of physical education.

TABLE VI

1.	Number of universities reporting cases of "punch drunkenness" resulting from boxing program	12
	(Types of disorders included—disturbances of equilibrium, vacant look in eyes, headache, dizziness, personality changes, deterioration of concentration and attention, impediment of speech, vomiting, unsteady gait.)	
2.	Number of schools reporting amnesia cases attributed to boxing	4
3.	Other types of injuries listed:	
	Concussion	Dislocated shoulder
	Black eyes	Fractured ribs
	Broken noses	Broken hands
	Fracture of neck and death	Partial paralysis
	Loss of teeth	Perforated ear drums
	Cuts on face	One suicide following massive collapse of lung

As tabulated in Table VI, twelve universities stated that they had had cases of "punch drunkenness" in their institutions that could be attributed to boxing. Four universities reported having had cases of amnesia due to blows to the head received in boxing contests.

TABLE VII

RESPONSES FROM QUESTIONNAIRES SENT TO FORTY-SIX OUTSTANDING NEUROLOGISTS AND PSYCHIATRISTS

	Per Cent Yes	Per Cent No	Per Cent No Knowledge	Per Cent Doubtful
1. Have you had any cases of physical or mental impairment that were directly traceable to participation in boxing?..	33.3	66.7		
2. Have you had any cases of amnesia?..	16.6	83.4		
3. Have you had any deaths due to boxing?				
4. Do you feel that boxing is a hygienic activity for boys of college age?	57.1	21.4	11.9	9.5
5. Can repeated blows on the head over a period of two to four years cause a gradual change in mental pattern, etc., of the individual?	76.1	2.3	7.9	14.2

Table VII summarizes the results of questions asked of forty-six leading neurologists and psychiatrists. In some respects the facts given in this table do not bear directly on the question of the study, since the experience of these doctors was gained from boxers of all kinds, professional as well as amateurs, and undoubtedly most of their cases are not resultant from college boxing directly.

Apparently one-third of the neurologists and psychiatrists have treated cases of mental impairment directly traceable to boxing. Many other mental cases with boxing history were treated but the disability could not be traced directly to boxing.

Of these doctors, 76.1 per cent stated that repeated blows to the head over a period of years can cause gradual changes in mental patterns of the individual, but only 21.4 per cent considered boxing as

unhygienic. Their apparent inconsistency can probably be explained by the fact that many of these men believe that college boxing can be controlled so as to prevent repeated blows to the head.

TABLE VIII

REASONS GIVEN WHY BOXING IS NOT OR SHOULD NOT BE SPONSORED AS REPORTED BY EIGHTY ATHLETIC AND HEALTH SERVICE DIRECTORS

	(38) Athletic Directors	(42) Health Service Directors	Total	Per Cent
Injuries (dangers outweigh advantages)..	11	9	20	25
Hard to control crowds, undesirable spectators, etc.	8	6	14	17.5
Insufficient interest of student body	6	7	13	16.2
Other schools quitting or not sponsoring boxing makes it hard to schedule meets.	8	5	13	16.2
Does not lend itself to intercollegiate competition; too difficult to control ...	4	7	11	13.7
Surest way of winning is by knockout; only sport which approves of deliberate punching of opponent's head	4	6	10	12.5
Faculty opposes	8	1	9	11.2
Financial reasons	5	3	8	10
Hard to match students of equal ability; weight not safe factor	4	3	7	8.5
Other sports same benefits without such dangers	4	3	7	8.5
No value seen in competition with other schools	3	2	5	6.2
Lack of adequate instruction	3	2	5	6.2
Adaptation of professional sport to college is undesirable	2	3	5	6.2
Outstanding boys soon have weight to themselves and others lose interest	3		3	3.7
"Taker" suffers most	2	1	3	3.7
Lack of facilities		2	2	2.5
Managers hound good boys to turn "pro".	2		2	2.5
Rules do not adequately cover all situations; good officials hard to find; creates ill feeling	2		2	2.5
More humiliating to loser if knockout....	2		2	2.5
Danger of engendering negative values as fear, hate, inferiority, bullying, etc...	2		2	2.5

Table VIII gives a picture of the reasons why athletic directors and health service directors do not believe boxing should be included in college sports programs. It will be noted that the reason most mentioned was that the dangers outweigh the advantages of sponsoring the sport. The second most mentioned reason was the difficulty of controlling spectators. The list of reasons gives point to the difficulty of organization and administration of boxing as a college activity.

By far the most constant findings on the autopsy reports received from many pathologists and coroners were edema and petechial hemorrhages of the brain, and cerebral hemorrhage.

GENERAL DISCUSSION

As far as acute injuries are concerned, there is no greater percentage of accidents occurring in boxing than in many other sports. There are very few deaths reported from the various schools which sponsor boxing, although at the University of Illinois we have had two deaths which were directly the result of this sport. One student died immediately following a knock-out. The injury of the other student was considered trivial at the time of the contest. In fact, this participant and his second wanted to proceed with the bout. Nevertheless, it was stopped. He complained of some dizziness at the showers and it was deemed advisable to hospitalize him. He was seen at the hospital a little later and was resting well and felt much improved. The physician in charge could find nothing on physical examination to be alarmed about. This student suddenly became worse and died within a few minutes.

One student, an amateur boxer before he entered the University, showed unmistakable evidence of the "punch drunk" syndrome. This mental disturbance has become gradually worse and this year his mental patterns have deviated at times so far from the normal that it was found necessary to advise him to withdraw from the University.

Another student with amnesia definitely dating from boxing in one of the University classes, packed his grip, left on a train and when he regained his normal faculties found himself in a town about one hundred miles away. During the investigation it was found that the bout was supervised by the boxing instructors, who were using all precautionary measures to prevent injuries. Nothing unusual was noticed during the bout. The student was not even knocked off his feet during the contest.

Another student came into the Health Service complaining of a peculiar feeling of fullness in his head with a dull headache in left frontal and temporal regions and nervousness, which he definitely dates to one month ago while he was taking the final practical examination in the professional physical education course in boxing. These symptoms are increasing in intensity and at present this student is so nervous that it is difficult for him to study. Although he was not knocked down, he has also developed some disturbance of the extra-ocular muscles.

Since injuries occurring in various sports are not always reported to the Health Service of our colleges and universities, undoubtedly many are given medical attention by other physicians and trainers. Consequently, any data on injuries is apt to be incomplete.

Schools have reported such injuries as hematoma, broken noses, loss of teeth, cuts on the face, dislocated shoulder, fractured ribs, broken hands, fractured jaws, perforated ear-drum, partial paralysis, etc. Although some of these injuries are very uncomfortable to the patient and may leave physical deformities they are probably no more frequent

than occur in many other sports. However, grave concern should be given to the danger of cerebral injuries. Deaths have been attributed to cardiac inhibition by blows over the heart, but aside from this, death almost invariably is a direct or indirect result of brain trauma. By far the most important aspect of brain injuries resolves itself around the mental disturbances that may follow the accumulative effect of repeated blows to the head. Following blows on the head, a knock-out, amnesia, mental confusion, grogginess, etc., are definite symptoms of brain injury, whether it occurs in an accidental fall, automobile accident, a fight, or an intentionally delivered blow in boxing. The "punch drunk" syndrome is a definite entity which can follow brain injury, frequently simulating certain mental disturbances that follow diseases of the central nervous system. It is more scientifically referred to as traumatic encephalopathy or dementia pugilistica.

In reviewing the literature on traumatic brain injuries, postmortem examinations have definitely revealed pathological evidence of what happens. Martland and Beling,[2] in summarizing the results of their examinations, found that (1) injuries of the head with slight or no evidence of other external injuries are followed in some cases by death or clinical symptoms indicating structural damage to deep parts of the brain; (2) the damage manifests itself as minute multiple punctate hemorrhages in areas supplied by the terminal branches of the central ganglionic system of vessels; (3) damage frequently occurs in the basal ganglia due to contercoupe effect on the cisterna interpeduncularis with subsequent jamming of fluid in the perivascular spaces; (4) microscopic examination revealed hemorrhages surrounding vessels so frequently seen in other types of encephalitis. Martland's[3] article, "Punch Drunk," in the *Journal of American Medical Association* states that following repeated injuries to the brain, there is a replacement gliosis, or even that progressive degeneration of the lesions may follow as found in paralysis agitans or epidemic encephalitis (sleeping sickness). Cassasa,[4] Strauss and Savitsky,[5] and Windelman and Eckel [6] have reported valuable information on brain damage following head injuries. Parker[7] reported three cases among professional boxers in which the symptoms were those of encephalitis.

The symptoms of "punch drunkenness" compiled by Carroll [8] are as follows: timing fails, legs are shaky after blows to head, the defense becomes less effective, there is slight dragging of feet, there is deterioration in concentration, attention, and memory, also impediment of speech and a staring expression. In severe cases, the voice is thick, halting, and guttural, the gait is unsteady, the vision and hearing may tend to fail, and there is frequently headache, dizziness, and tinnitus (ringing in the ears). Mental and personality changes develop. The punch drunk performer does not realize there is something wrong. The type of boxer is a large factor. Probably no head blow is taken with impunity

and each knockout causes definite and irreparable damage. If they are repeated for long periods, nerve cell insufficiency develops.

Winterstein [9] in his report on "Head Injuries Attributed to Boxing" states that immediate effect from a single punch may produce a "knockout" syndrome of unconsciousness, loss of muscle tone, and alteration of reflexes. It may cause amnesia, an unconscious gap of memory, or retrograde amnesia as well, in which the boxer saw the blow coming but does not remember the punch, or has forgotten he ever fought. Or he may have a combination of these effects, but from all outward appearances have normal activity. Remote effects reported by Winterstein are (1) disturbed equilibrium, (2) the Rhomberg sign is positive and the affected person walks unsteadily, (3) articulation is disturbed, (4) the affected person may develop a vacant look in the eyes, (5) he has a bad memory for recent events, and (6) has difficulty in concentration.

Glazer and Shafer [10] report that 80 per cent of brain injuries show sequelae in which the patient suffers from subjective symptoms such as headache and dizziness. He also states that 9 per cent show mental changes which do not appear until an interval of months have passed following the injury.

Four other schools have reported one or more cases of amnesia lasting from eighteen to forty-eight hours.

Since the remote symptoms develop insidiously or slowly, it is possible that students can go through college engaging in boxing without showing much evidence of changes in personality, mental patterns, concentration, etc., and in a few years after they have finished may definitely present those symptoms of mental degeneration.

There is no other college sport whose chief objective is to beat an opponent by striking him in the most vital parts of the body, namely, the head, heart, and kidney region. According to the New National Collegiate Boxing Association, no draw can be called. Naturally, the quickest and surest way to win is by a knockout or a damaging punch. Even though rules and regulations have made the sport much safer than formerly, there are several factors which cannot be controlled. We have reports from schools that interpretation of the rules has caused dissension and ill feeling among the participants, the referee, and the coaches involved. It is impossible to match students equally. Even if that could be done, it is possible for both contestants to take severe punishment on the head, and yet the bout would not be stopped because no advantage would be shown by either. Many schools have small boxing squads. Consequently, in practice it is often necessary for training purposes to "work out" with other members of the squad who belong in a different weight class. It is impossible to govern how hard a person is to hit an opponent. Speed is important and a quick punch must be delivered with force behind it.

Owing to the difficulties we have had in the promotion of boxing at the University of Illinois, the question of discontinuing the sport in all phases of the physical education program has been thoroughly discussed. Several years ago all competitive boxing tournaments were eliminated. Up to that time we had been very unsuccessful in running boxing tournaments in a manner that seemed to be beneficial to those participating. The boxing tournament added spice to our intramural program and attracted far more spectator interest than any other sport, and it was not without considerable thought that the elimination was made.

The instructors in boxing even went so far as to devise a set of rules which made the sport like a fencing bout with the emphasis on defense and reduced considerably the number of blows landed in any one bout. Only after all safety devices, including helmets for protection against blows to the head, were tried and found unsatisfactory was competitive boxing discontinued.

This study was made to find what the experience of other educational institutions has been with boxing. It also seemed desirable to know the opinions of experts both in the medical profession and in athletics and physical education.

Considerable difference of opinions is shown by professional men of apparently equal standing, depending no doubt upon their experience with the sport, or upon prejudice for or against boxing in the schools. Because of these same facts, entirely different conclusions may be drawn by various students of the statistics we have compiled.

After consideration of the facts and opinions brought out by this study there seems to be little place for intercollegiate boxing. Of the athletic directors questioned on the matter, 50.7 per cent feel this way about the sport; 15 per cent of college athletic directors are not in favor of boxing, even as an intramural activity; 41 per cent of college health service directors questioned reported that boxing was not a hygienic activity for college students.

The leaders in intercollegiate boxing have tried hard to make the sport acceptable by rules refinement and they undoubtedly have made a definite improvement. The rules committee [11] has recently included a rule eliminating anyone who has ever participated in a public boxing contest except those carried between colleges, high schools, or preparatory schools.

The rules give the various officials the power to stop a fight when and if either boxer appears to be injured to such an extent that it may be dangerous to continue. This ruling is obviously a good one but many times the damage is already done when the bout is stopped. It does, however, eliminate continued pummeling of a man unable to defend himself. There seems to be nothing in the rules, however, to

take care of the bouts in which both boxers are being hurt and no advantage is being shown by either one.

The truth of the matter is that in all boxing contests the main objective of a bout is to injure the other contestant. This blunt statement will, no doubt, cause proponents of boxing to raise up and deny it in a loud voice. They will point out the point system used for determining winners and try to show that the objective of boxing is to outpoint an opponent rather than to injure him. The rules state that to win by a decision is just as commendable as to win by a knock-out.

The fact remains, however, that a boxer, to be successful, must hit quickly, and a fast punch can never be anything but a hard punch. No boxer ever developed into a champion by practicing the art of "pulling" his punches. It is also generally known by boxers, whether the fact is emphasized by coaches or not, that a hard punch neatly placed will slow up an opponent and make him more vulnerable. The knowledge that the bout will be stopped and a decision rendered in favor of the aggressor when an opponent shows signs of being hurt does not do away with hard hitting to the head. This fact is brought out by the results of the N.C.A.A. Boxing Tournament held at Madison, Wisconsin, in 1939, during which there were twelve knock-outs scored.

CONCLUSIONS

After careful study of the data collected, the Committee is of the unanimous opinion that boxing should not be included in the sports program of an educational institution, either as a curricular or an extra-curricular activity. The basis for this conclusion is as follows:

1. The objective of all offensive maneuvers in boxing is to injure an opponent. The more efficiently an offensive is executed, the greater the injury incurred.

2. The type of injuries most common are insidious in nature and in many cases not recognized by either participants or coaches. The effects of head blows are cumulative and are not recognized in early stages. Knock-outs are not recorded as injuries in this sport.

3. Contests of intramural or intercollegiate nature are impossible to control, hence the dangers of ill effects to participants outweigh the values of the competition.

4. Instructional classes in boxing are not particularly dangerous, but it is impossible to justify teaching an activity and at the same time to advise students against participation in the activity taught.

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A Study of the Distance Traversed and the Time Spent in Active Play in Women's Basketball

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INTRODUCTION

IN THIS study an attempt has been made to compare women's two-court and three-court basketball with respect to the effort expended by the participants. The distance traveled and the amount of time spent in strenuous activity were assumed to be an indirect measure of the energy expenditure in the game. Such information, together with the data which the physiologists may furnish, should contribute to the formulation of a sound basis for the evaluation of basketball in the physical education program and for the adaptation of the game to the capacity of the players.

STATEMENT OF PROBLEM

The problem is to compare the distance traveled and the time spent in activities of different speed or intensity of effort (standing, walking, running, jumping, dashing) by players of different degrees of skill in the games of two-court and three-court basketball in order to obtain an indirect measure of the relative work done and hence, of the "organic demands" on the player in the two types of game.

PROCEDURE

The distance traveled was obtained by charting the path of the player on onion-skin paper superimposed on stiff cardboard on which the playing court was drawn to scale. A separate record was made for each minute of play observed. Distances were computed from the measurement of these charted paths. In preliminary experiments in which the distance traveled by an individual running over an irregular floor pattern was measured directly by means of a steel tape, it was determined that the average error in the indirect method of measurement was 1.3 per cent. To determine reliability, simultaneous records were taken during play in the game by two to four observers. The coefficients of correlation between such records ranged from $.81 \pm .05$ to $.95 \pm .01$ with a median of $.93 \pm .01$. Records were measured in duplicate or triplicate

by means of a measurer of curves. The average error of measurement calculated from 100 records chosen at random was 0.3 per cent.

As the path of the player was charted, the degree of intensity of her activity was also recorded. Standing or walking was designated as *a* activity; running or jumping, *b* activity; and dashing, *c* activity. Each time a girl completed one of these types of activity, a dot was placed on the record and marked *a*, *b*, or *c*, accordingly. At the same time, *a*, *b*, or *c* was called out to an assisting time-keeper who recorded the letter and the time at which it was called.

SELECTION OF PLAYERS

Players of superior skill were chosen from the advanced group at the University of California and from the Pacific Association of the Amateur Athletic Union. The play of the former group was entirely in intramural tournaments in which the competition may be described as keen but not intense; the playing court was 43 feet by 83 feet. In the P.A.A. group, composed of independent commercial teams, competition was quite intense; their playing court was 43 feet by 77 feet. This group was considered somewhat more skillful than the college group. Players of intermediate skill were chosen from the intermediate group at the University of California and from the Oakland Industrial Amateur Athletic League, the college players probably being the more skillful of the two groups. Competition among the college players was entirely intramural, that of the other group between teams of various industrial firms belonging to the league. The playing court was 43 feet by 83 feet for the college group, 40 feet by 66 feet for the industrial group. Observations in the two-division game were made on players from the P.A.A., from the University of California advanced group, and from the O.I.A.A.L.; in the three-division game, on players from the advanced and intermediate groups at the University of California. Table I shows the number of players and the number of one minute records made of the various groups.

Special attention is drawn to the small group of advanced three-court players studied. From approximately sixty advanced players, two forwards and two guards were selected for observation in 1935 and 1936 since they were subjects in Hodgson's studies on the physiological effects of participation in basketball.[1,2] These players were observed during one season playing the two-court game and during the following season playing the three-court game. They played each year under the same conditions, in the same gymnasium, with the same coaches, and with

[1] P. Hodgson, "Studies in the Physiology of Activity: II: On Certain Reactions of College Women Following Participation in Two-court Basketball," THE RESEARCH QUARTERLY, VII (May, 1936), 45–55.

[2] P. Hodgson, "Studies in the Physiology of Activity: III: On Certain Reactions of College Women Following Participation in Three-court Basketball," THE RESEARCH QUARTERLY, X (October, 1939), 53–60.

[3] J. P. Guilford, *Psychometric Methods* (New York: McGraw-Hall Book Company, 1936).

teams of similar skill, in tournaments of similar organization. Under these circumstances it is assumed that records of the same individuals in the two games afford adequate basis for a valid comparison of the two games. To ascertain how representative these four individuals were of the group in which they played, records were taken of other advanced players at the University of California in the two-court game (Table II). Since the scores of each of the four special subjects were

TABLE I

NUMBER OF INDIVIDUALS STUDIED AND NUMBER OF RECORDS MADE

Group	Position					
	Forward		Center		Guard	
	No. of Cases	No. of 1″ Records	No. of Cases	No. of 1″ Records	No. of Cases	No. of 1″ Records
Intermediate Three-court U.C. 1935	18	284	9	141	11	258
Advanced Three-court U.C. 1936	3	129	4	100	4	200
Advanced Two-court U.C. 1935	6	225	..	..	5	182
Intermediate Three-court U.C. 1937	8	130	8	105	7	125
Intermediate Two-court O.I.A.A.L. 1937	9	155	..	..	5	64
Advanced Two-court U.C. 1937	7	200	..	..	5	162
Advanced Two-court P.A.A. 1937	5	72	..	..	5	63

within ± 1 sigma of the mean of the group these four may be considered representative of the entire group in the two-court game. Since the personnel and the level of skill of the entire group were so nearly the same for the three-court game it seems reasonable to assume that the records of these players may be considered representative of the advanced group at the University of California in the three-court game also.

From observations of players in these four groups it is possible to make comparisons between advanced and intermediate players in the two-court and in the three-court game. It is also possible to compare

TABLE II

SIGMA SCORES OF THE FOUR INDIVIDUALS IN ADVANCED TWO-COURT BASKETBALL U.C.

Player	Total Distance	Distance b+c activity	Time b+c activity
F^1	+0.26	+0.64	+0.21
F^2	−0.50	+0.27	+0.66
G^1	−1.37	+0.04	−0.06
G^2	−0.63	−0.08	+0.34

one type of game with the other for each skill level and to compare one playing position with another. The importance of the difference in size of the playing courts used cannot be accurately evaluated from the data available.

RESULTS AND DISCUSSION

Two-Court.—Results of observations made on the two advanced groups are presented in Table III. There is a reliable difference between the guards of the two groups with respect to the total distance traveled. The P.A.A. guards who traveled the greater distance played a player-

TABLE III

RELIABILITY OF THE DIFFERENCE BETWEEN P.A.A. ADVANCED AND U.C. ADVANCED TWO-COURT BASKETBALL

Pos.	N	Mean	σ	Pos.	N	Mean	σ	$\frac{D^*}{\sigma \text{ diff.}}$
Total Distance Traveled†								
FP.A.A.	5	212	19	FU.C.	12	225	52	0.77
GP.A.A.	5	232	22	GU.C.	7	172	21	*4.05*
Distance Traveled while Running and Dashing								
FP.A.A.	5	112	12	FU.C.	11	113	37	0.13
GP.A.A.	5	101	23	GU.C.	7	80	22	1.65
Percentage of Time Spent in Strenuous Activity								
FP.A.A.	5	12	2	FU.C.	11	18	8	2.05
GP.A.A.	5	11	2	GU.C.	7	13	7	0.81

* Throughout these tables the $\frac{D}{\sigma \text{ diff.}}$ for each comparison is italicized if it shows a very significant difference, that is, if the probability is 1 or less in 100 that so great a difference could arise by chance. These values were read from Fisher's tables for the significance of the difference of means of small samples.[1]

† Throughout this paper, distances reported are in feet per minute.

to-player type of defense while the U.C. guards played a shifting-zone type. The playing court of the more active group was slightly smaller. No reliable difference is found between the two groups of forwards when distance traveled is considered. Neither is a reliable difference found in distance traveled in *b* plus *c* types of activity, nor in time spent in strenuous activity, between players in the corresponding positions in the two groups.

Comparison of the intermediate players with the two advanced groups is shown in Tables IV and V. The advanced U.C. forwards spent a significantly greater amount of time and traveled a significantly greater distance in strenuous activity (b + c types) than did the intermediate forwards. Almost certainly a significant difference exists between the advanced U.C. guards and the intermediate guards, with respect to time spent and distance traveled in strenuous activity, the advanced players ranking higher for both time and distance. No reliable

difference is found in the total distance traveled by the advanced and the intermediate players in the guard position. When the O.I.A.A.L. intermediate players are compared with the P.A.A. advanced players, a significant difference is found in the total distance traveled and in the distance traveled and the time spent in strenuous activity by players in

TABLE IV

RELIABILITY OF THE DIFFERENCE BETWEEN O.I.A.A.L. INTERMEDIATE AND U.C. ADVANCED TWO-COURT BASKETBALL

Pos.	N	Mean	σ	Pos.	N	Mean	σ	$\frac{D}{\sigma \text{ diff.}}$
Total Distance Traveled								
FI.	9	159	31	FA.	12	225	52	*3.63*
GI.	5	160	22	GA.	7	172	21	1.00
Distance Traveled while Running or Dashing								
FI.	9	51	27	FA.	11	113	37	*4.35*
GI.	5	47	17	GA.	7	80	22	2.95†
Percentage of Time Spent in Strenuous Activity								
FI.	9	6	3	FA.	11	18	8	*4.95*
GI.	5	6	2	GA.	7	13	7	2.61†

† The probability is 5 in 100 that so great a difference could arise by chance.

corresponding positions. In every respect, the advanced players were more active than the intermediate. The playing court of the less active intermediate players was smaller than that used by either of the advanced groups.

Three-Court.—The number of players in the advanced group is too small to warrant statistical analysis of the data. However, on the basis of the assumption made above, that these four players observed may be considered representative of the entire group, the following comparison

TABLE V

RELIABILITY OF THE DIFFERENCE BETWEEN O.I.A.A.L. INTERMEDIATE AND P.A.A. ADVANCED TWO-COURT BASKETBALL

Pos.	N	Mean	σ	Pos.	N	Mean	σ	$\frac{D}{\sigma \text{ diff.}}$
Total Distance Traveled								
FI.	9	159	31	FA.	5	212	19	*3.93*
GI.	5	160	22	GA.	5	223	22	*4.65*
Distance Traveled while Running or Dashing								
FI.	9	51	27	FA.	5	112	12	*5.84*
GI.	5	47	17	GA.	5	101	23	*4.30*
Percentage of Time Spent in Strenuous Activity								
FI.	9	6	3	FA.	5	12	2	*5.33*
GI.	5	6	2	GA.	5	11	2	*3.88*

with the intermediate players is made. From the data in Table VI, it may be seen that the advanced players traveled a greater total distance, spent more time and traveled a greater distance in strenuous activity than did the intermediate players. The size of the playing court was the same for both groups. Thus for the three-court, as well as for the two-court game the effort expended seems to be greater for the advanced than for the intermediate player.

Comparison of Two-Court and Three-Court.—The comparison between the two types of game for players of superior skill is made on the basis of records of the four selected University of California students

TABLE VI

THREE-COURT BASKETBALL: ADVANCED AND INTERMEDIATE, U.C.

	Advanced			Intermediate		
Pos.	N	Mean	σ	N	Mean	σ
			Total Distance Traveled			
F	2	205	31	25	149	43
C	4	204	30	21	167	24
G	2	160	7	18	143	54
			Distance Traveled while Running and Dashing			
F	2	111	14	25	67	34
C	4	108	33	20	74	31
G	2	92	3	17	68	20
			Percentage of Time Spent in Strenuous Activity			
F	2	15	1	24	11	6
C	4	13	4	19	10	6
G	2	13	0	17	11	5

discussed above. It may be emphasized again that each girl's record in the one game is compared with her own record in the other. Data are presented in Table VII. In no case is there a reliable difference in distance traveled or time spent in strenuous activity by the same player in the two games. Neither is a significant difference found when distance traveled per minute is considered.

Records of the O.I.A.A.L. players in the two-court game are compared with those of U.C. intermediate players in the three-court game. The data are presented in Table VIII. The intermediate three-court players spent a significantly greater amount of time in strenuous activity than did the two-court players. The three-court guards traveled a greater distance in $b + c$ activity than the two-court guards, the difference being a reliable one. No significant difference is found for the forwards in this respect. The playing court used in the two-division game was smaller than that used in the three-division game.

Size of Playing Court.—The difference in size of playing court must be considered as a factor contributing to the differences found. The im-

TABLE VII

RELIABILITY OF THE DIFFERENCE BETWEEN ADVANCED TWO-COURT AND THREE-COURT AT U.C.

	Two-Court		Three-Court		
Pos.	N	Mean	N	Mean	$\frac{D}{\sigma \text{ diff.}}$
		Total Distance Traveled			
F_1	122	243	63	238	0.57
F_2	66	200	63	173	1.74
G_1	63	149	115	168	1.83
G_2	86	160	64	154	0.50
		Distance Traveled while Running or Dashing			
F_1	143	139	29	126	0.95
F_2	66	124	57	98	2.31
G_1	71	83	56	97	1.18
G_2	84	80	61	90	0.93
		Percentage of Time Spent in Strenuous Activity			
F_1	119	32	64	26	0.87
F_2	65	38	62	22	2.44
G_1	48	23	79	23	0.36
G_2	81	26	64	21	0.77

portance of this factor cannot be estimated with certainty. However, since the same qualitative differences in activity exist between the two skill groups when the size of the court is constant, and since differences in activity are found for one playing position and not for the other when the size of the court differs, it seems justifiable to assume that the size of court has less effect upon the energy expenditure of players than skill or playing position.

TABLE VIII

RELIABILITY OF THE DIFFERENCE BETWEEN INTERMEDIATE O.I.A.A.L. TWO-COURT AND U.C. INTERMEDIATE THREE-COURT BASKETBALL

	Two-Court		Three-Court		
Pos.	N	Mean	N	Mean	$\frac{D}{\sigma \text{ diff.}}$
		Total Distance Traveled			
F	9	159	25	149	0.76
G	5	160	18	143	1.01
		Distance Traveled while Running and Dashing			
F	9	51	25	67	1.42
G	5	47	17	68	2.38†
		Percentage of Time Spent in Strenuous Activity			
F	9	6	24	11	*3.33*
G	5	6	17	11	*3.21*

†The probability is 5 in 100 that so great a difference could arise by chance.

CONCLUSION

In this study on girls of college age, the distance traveled and the amount of time spent in strenuous activity by a superior player seem to depend upon her skill and that of the group rather than upon the type of game played. The less skillful players observed were more active in the three-court than in the two-court game although the possibility must be recognized that the differences noted may be due to a difference in skill between the two groups studied rather than to a difference in the type of game played. The position of guard seems to be less demanding than that of forward, especially when the shifting zone type of defense is used by the guards. Interpretation of the results of this study should be restricted to girls of college age and should not be extended to younger players without further experimental evidence obtained from the play of younger age groups.

Analysis of the Basic Factors Involved in Fancy Diving

By Fred Lanoue

Coach of Swimming, Georgia School of Technology

FOREWORD

THERE is a definite antipathy on the part of many teachers and coaches to mechanical explanations of physical actions because they feel that exponents of mechanistic theories lay claim to knowledge that they do not possess. This is not quite true. The fact is, that the terminology of science is so much more precise than simple description, that basic principles can be much more clearly isolated and evaluated through that terminology. If a scientific gunner makes his shell hit the target on the first try you may be sure that he has figured that, for a given quantity and quality of powder, weight of projectile, length, inclination and rifling of the barrel and air resistance, the projectile will behave in a certain manner. In other words, he has isolated and evaluated the different factors involved in the projection of the shell to such an extent that he predicts its path exactly. Another man, without knowing anything about the gun or shell may also score a direct hit. His results are just as good, but which man would be more valuable in a place like West Point teaching embryonic officers to command gun squads? Or which type of man would be more valuable in a physical education school teaching embryonic teachers?

They both have their places, the expert who knows *why* the shell behaves as it does, and the gunner who shoots just as well or better intuitively. The point is, that the gift of doing things right intuitively belongs to a few, but the opportunity to figure out mathematically the correct way is open to everyone.

The coaching of fancy diving is a rather haphazard affair because the better coaches know intuitively what to do and the poorer ones just guess. Most good coaches are former divers and so can sense the right thing to do, but less gifted individuals have to use the trial and error method which, besides being slower, sets up many bad habits which are difficult to eradicate. This is unnecessary, as fancy diving is readily explained in terms of simple mechanics which require little technical knowledge for their interpretation.

AIM

The aim of this study is to point out the basic mechanics of the factors involved in the height and distance of a dive, the turning and the twisting of the body in the air, and the control of a dive generally.

MATERIAL

The material consisted of several reels of slow-motion moving pictures of champion divers which were taken directly from the side, opposite the forward end of the board. Thus a profile view of the whole dive was obtained.

PROCEDURE

The procedure consisted of projecting the dives onto a screen and then, by stopping the projector, of gathering the desired data by tracing the figures. Angles may be read directly off the screen but linear measurements must be multiplied by a constant called a "multiplier" to convert screen measurements to actual ones. For instance, if an image of a man on the screen was 6 inches tall and we knew the man was actually 66 inches tall, then our multiplier would be 11 and we would multiply our screen measurement by eleven to get the actual. Measurements of time may be made by finding the time represented by one frame of the film. This is ascertained by dropping an object a known distance during the taking of the film. In this case a twelve-pound shot was dropped 86 inches. It took 32 pictures to complete the fall from hand to ground. Applying the formula applicable to a falling body, S equals $\frac{1}{2}gt^2$, where S equals distance, g equals acceleration of gravity or 32.2, and t equals time, we solve for t, or time for the object to drop, and divide it by 32. The time represented by one frame is found to be .021 seconds.

DIVE HEIGHT

There are two considerations in studying the height of the dive. First, the problem of pushing the board down, and then the problem of getting off it. Pushing it down is controlled mostly by timing the arm swing and leg thrust, and to a lesser extent by the height and length of the hurdle. Although the hurdle height is theoretically very important, practically it makes but little difference, as was indicated by a study that correlated hurdle height and dive height as we measured them on the screen. The correlation was only .0239. The small number of cases which were available, only 59, while insufficient for a true statistical study, is large enough to show a significant trend. It appears that a medium height of 20 to 28 inches is best for the hurdle. Too low a hurdle doesn't permit the diver to gather himself for the thrust, and too high a hurdle tends to complicate the timing and balance.

BOARD ACTION

Very few people know exactly the sequence of movements in taking a spring. In Fig. I is a series of skeleton tracings showing just what the arms and legs are doing as we spring on the board.

This was taken directly from the film, so there is no question as to its accuracy. In this case the diver is going to do a halfgainer, but repetitions of these tracings have shown that these actions are exactly the same up to and including position 6, regardless of what the dive is.

Mechanically speaking, the action of depressing the board is brought about in the following way. The inertia of the falling body is used to depress the board and the legs are not straightened until the board has gone all the way down and has enough potential energy to throw the body upward, accelerated by the straightening of knees and ankles plus

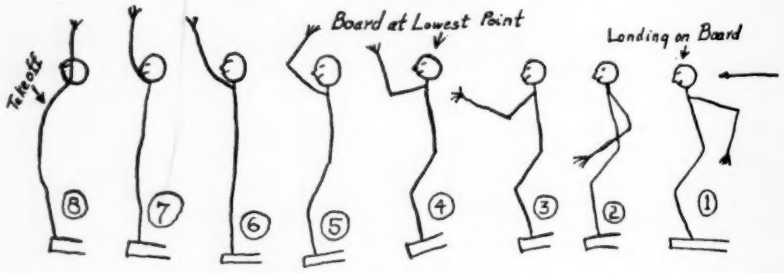

FIG. I

inertia of the already upflung arms. With the arms already swinging downward at contact with the board, the inertia effect when they reach the top of the swing is to pull the body up. The body is already starting up, so the arms accelerate its rise.

The practical significance of the whole action from a coaching standpoint is that the arms must be swung up early enough so that they will have time to start in the direction of desired rotation at about midway of the rise of the board, and the legs are not straightened until the board is fully depressed.

FLIGHT OF DIVE

Once the diver leaves the board we must consider him a simple projectile, subject to all the laws of projection. First, the height he achieves is measured with the formula

$$H = (V)(\sin\theta)t_1 - \tfrac{1}{2}gt^2 \qquad H = V_0\, t \sin\theta$$

where H = Height, V = takeoff velocity, θ = takeoff angle with the horizontal, t_1 = time from takeoff to peak of dive, and g = acceleration of gravity or 32.2 ft./sec^2.

We are able to calculate the V from the distance traveled and the time of takeoff on the film and we can measure θ directly, so taking the actual values we found V = 20 ft. per sec. and $\theta = 73°$ with its sine = .956. First we get the total upward velocity, which is 20 x .956 or 19.12 ft./sec. Then solving for t_1

$$\frac{\text{initial velocity}}{\text{rate of losing velocity}} = \frac{19.12}{32.2} = .59 \text{ sec.} = t_1$$

then,

$$H = (V_0)(\sin\theta)t_1 - \tfrac{1}{2}gt^2{}_1$$
$$H = 20 \text{ x } .956 \text{ x } .59 - (16.1)(.59^2)$$
$$H = 11.28 - 5.6$$
$$H = 5.68 \text{ ft.}$$

To find the distance of the dive, given the same V_0 and θ_0

$$D = V(t_1 + t_2) \cos. \theta$$

solving for t_2 or time taken to drop from the peak of the dive to the water, in this case from a board 3 ft. above the water:

$$S = 5.68 + 3 \text{ ft.} = 8.68 \text{ ft.}$$
$$S = \tfrac{1}{2}gt^2$$
$$8.68 = \tfrac{1}{2}(32.2)\, t_2^2$$
$$t_2 = .73 \text{ sec.}$$

hence
$$D = (20)\ (.29)\ (.59 + .73)$$
$$D = 7.65 \text{ ft.}$$

As measured by a stop watch, a good low board dive generally takes from 1.1 to 1.3 seconds.

Either the height or the distance of any dive may be computed very easily from these formulas, but as they are both results of what is done before leaving the board, the observation of importance is that the greater the takeoff velocity and the greater the takeoff angle with the horizontal the greater is the height of the dive.

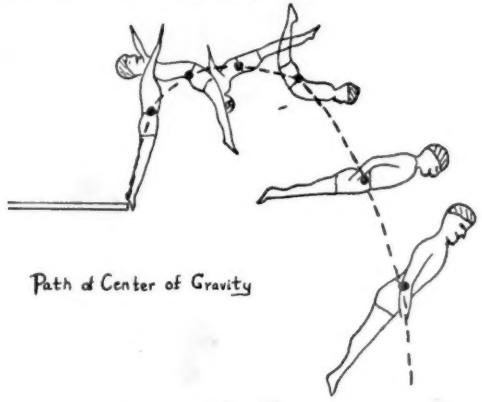

FIG. II

The course of the center of gravity of the body after leaving the board is not affected by movements of the body or the limbs. It follows a regular parabolic curve (see Fig. II), or, in the case of the "spotter" dive, a straight line up and down.

ROTATION

Rotation, or turning on the transverse axis of the body, as in a somersault, is most interesting mechanically. Slow motion pictures show clearly that *all* divers start turns during the last half of the rise of the board, although it is done so smoothly that many people find it incredible.

The two main factors producing a turning movement are, first, the amount and speed of bending at the waist in the direction of the desired turn, and second, the angular speed with which the center of gravity

of the body is rotating around the toes at the instant of leaving the board. These two factors dominate the situation so much that if we know both factors we can predict with astonishing accuracy the total achieved rotation if the body is in a layout position. Changing from a layout to a pike or tuck position always accelerates the rotation and renders predictions extremely difficult because of the variable speed of changing from one body position to another. A sample prediction as applied to a backward one and one-half somersault layout follows:

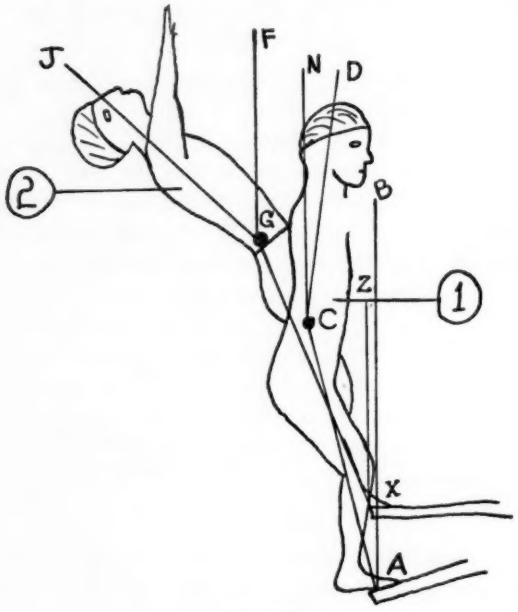

FIG. III

In Fig. III, position 1 shows the diver when board is at its lowest point, and 2 shows the diver just leaving the board. In figure 1, we erect *AB*, a perpendicular from the ball of his foot, and draw *AC* to his C. of G. Then angle *CAB* shows the angular lean of his body in relation to the vertical. We erect *CN*, a perpendicular from *C*, and then draw *DC* to bisect the base of the neck. The angle *NCD* gives the angular position of the trunk in relation to the vertical.

In figure II, we erect *XZ*, a perpendicular from the ball of the foot, and draw *XG* to his C. of G. Angle *GXZ* shows the angular lean of the whole body from the vertical. We erect *GF*, a perpendicular from the C. of G., and draw *GJ* to bisect the base of the neck. Angle *JGF* shows the angular position of the trunk in relation to the vertical.

The difference between angles *CAB* and *GXZ* shows how much the body, as a whole, has rotated in a counter clockwise direction during

the spring and the difference between angles *NCD* and *JGF* shows the amount of angular rotation of the trunk during the spring. In this case it was found that rotation due to body lean during the takeoff amounted to 3.5 degrees, and as the takeoff took nine picture frames, the average angular velocity from this source was .4 degrees per frame. The body bend during the takeoff amounted to 49 degrees, and dividing it by nine gives 5.4 degrees per frame as the average angular velocity of the trunk. The whole dive from board to water took 72 frames, so multiplying the

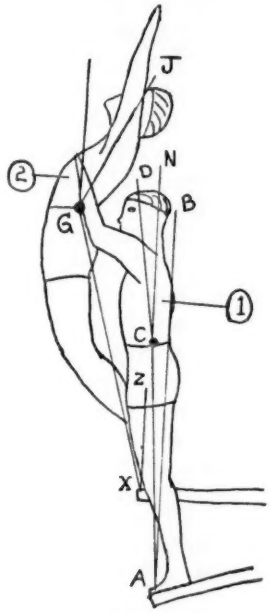

FIG. IV

two angular velocities by 72 gives us 28.8 degrees for body lean and 388.8 degrees for body bend. As they are both in a counterclockwise direction, we add them together and predict the rotation to be 417.6 degrees. The actual rotation was 475 degrees.

As a check on our assumptions, let us take the half gainer dive (see Fig. IV). We erect and draw the same lines as in the preceding dive.

The takeoff and the dive time are the same as in the preceding dive, nine and seventy-two, respectively. The body lean is 12.5 degrees, divided by nine it equals 1.4 degrees per frame average angular velocity. The dive lasts for 72 frames, so 72 x 1.4 degrees accounts for 100.8 degrees rotation in a counter clockwise direction as a result of body lean during the takeoff. The total bending during the takeoff equals 36 degrees, and dividing this by nine makes the average bending rate

4 degrees per frame. Multiplying 72 x 4 degrees accounts for 288 degrees rotation in a clockwise direction as a result of body bend. Subtracting the smaller force from the larger we predict a total rotation of 187.2 degrees in a clockwise direction. Actual rotation is 180 degrees.

The third factor involved in rotation is length of lever or position of the body. If a straight body rotating at a given speed be changed to a tuck or pike position, its angular speed will be greatly accelerated, depending on how close to its Center of Gravity the segments of the body are concentrated. Ordinarily the C. of G. of an erect person is located approximately at the midpoint of the body, and the center of mass of each half is about 18 inches from the C. of G. of the whole body. When a person is in a tight tuck position the centers of mass of the different segments are roughly about 6 inches from the C. of G. of the whole. If a person in a layout position is making a complete rotation every second, that means that the center of mass of his upper body is traveling about 10 feet per second. If he should suddenly change to a tuck position, this center of mass of one-half the body would have the same linear speed around the C. of G. but working through a 6-inch radius instead of an 18-inch one would force it to make three revolutions to cover 10 feet per second.

The reverse is true also, and that is why a diver seems to stop turning in changing from a tuck to a layout; in reality he is only turning about one-third as fast.

TWIST DIVES

The basic explanation of twist dives goes back to why a cat lands on his feet when dropped upside down. This was a source of much dispute until Marey employed moving pictures to verify his deductions. He showed that the cat dropped an appreciable distance before making any move at all. Why the cat can twist in the air in apparent defiance to Newton's Law, "that for every action there must be an equal and opposite reaction," is explained by the fact that equal forces acting through different radii move different angular distances although they move the same linear distance.

In Fig. V, *A* shows the cat dropping freely with front and back legs straight. *B* shows the front legs down to the chest and rear legs extended. Of course, when the front legs are twisted to the right the hind legs must go to the left, but although the centers of mass move the same linear distance, that of the front legs moves through a greater angle, as the center of mass of the hind legs is way out near the knees and that of the front legs is close to the shoulders. Then in *C* the operation is reversed and the hind legs twist farther around than the front ones. By repeating these movements, the number of times depending on his agility and flexibility, the cat eventually arrives at an upright position.

A fancy diver does much the same thing although he cannot bend his knees, and in some cases does not choose to bend his arms. He accomplishes this merely by bending at the hips.

Basically all twist dives are executed by making an angle greater or less than 180 degrees by bending the body out of a straight line position into either a pike or an arch, then twisting one-half on its long axis followed by a straightening of the body. If the body is straight, twisting one-half would merely cause the other half to rotate an equal amount in the opposite direction, so the total rotation would be nil. The part played by extending the arms outward from the long axis of the upper body is to increase the moment of inertia about this axis.

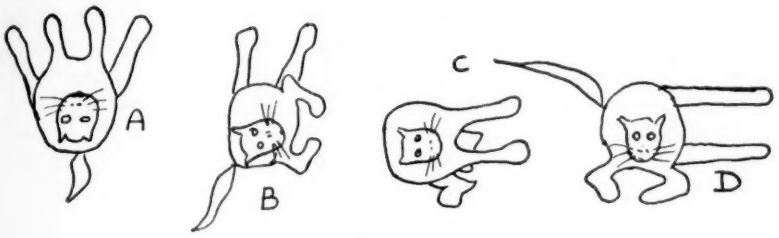

FIG. V

This facilitates using the upper part of the body as an anchor for the subsequent twisting movement of the hips and legs. As a corollary, when the legs are used as an anchor, the arms are brought closer to the long axis, either by drawing them closer to the sides or by extending them overhead. The head plays the same part as the arms, except that its displacement from the long axis is not counter balanced as one arm is by the other, but results in a shift in the axis of rotation from its previous position.

In practice, most divers make use of the arms to assist in twisting, but it is quite possible and easy for a diver to execute twisting dives with hands strapped to his sides, or better yet, with arms fully extended overhead. The arms by themselves are incapable of producing rotation, as may be proved by immobilizing the body with splints to eliminate flexion or extension at the hips and then trying to do twists. There is a popular swimming stunt called the rolling log which shows the true twisting technique, in which the body remains practically straight throughout.

Knowledge Test of Syphilis and Gonorrhea

By Sylvia Orringer Denenholz
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New York City High Schools

IN A recent article, a study of the knowledge of syphilis and gonorrhea possessed by a group of undergraduate women of The Pennsylvania State College was abstracted.[1] Inquiries about this study and requests for the test used as a basis were received from various parts of the United States. The test is accordingly given below,[2] with the acceptable answers to the questions shown in parentheses following each question.

KNOWLEDGE TEST OF SYPHILIS AND GONORRHEA

Part I

Directions—In the left hand margin opposite each statement, you will find the letters T, F, and D. If you think or know the *entire* statement is true, draw a circle around the letter T. If the statement is false, circle the letter F. If you are doubtful of the answer, circle the letter D.

Answer All Statements *Do Not Guess*

T F D 1. Treatment of syphilis, even if recognized, cannot be begun in the primary stage. (F)

T F D 2. Syphilis frequently causes heart disease. (T)

T F D 3. The eyes and ears of children afflicted with syphilis are organs that are seldom affected. (F)

T F D 4. Syphilis is transmitted to the unborn child by nearly all pregnant syphilitic mothers. (T)

T F D 5. Congenital (contracted before or at birth) syphilis can be prevented. (T)

T F D 6. Treatment during pregnancy of the syphilitic mother cures her of syphilis and protects the child. (F)

T F D 7. Any State Department of Health will send, upon request, a list of clinics where treatment for syphilis is available. (T)

T F D 8. Treatment of syphilitic mothers during the early months of pregnancy results in healthy non-syphilitic children in almost all cases. (T)

T F D 9. It is still doubtful if syphilis can be definitely arrested or cured even when treated. (F)

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1 Sylvia Orringer, "How Much Do College Women Know about Syphilis and Gonorrhea?" Research Quarterly, 10:1 (March 1939) 80.

2 Editor's Note: The author has kindly offered the "Knowledge Test of Syphilis and Gonorrhea" to any who may wish to make use of it. Proper recognition should be given to the author if the test is reproduced. It is desired to compare the results that may be obtained from the various administrations of the test, and so the author would appreciate receiving information as to such results from anyone who uses the test.

T F D 10. Drug stores sell self-administrable medicinal products that are effective in the treatment of syphilis. (F)
T F D 11. A registered pharmacist is a good source of advice about syphilis. (F)
T F D 12. It is unnecessary for the non-syphilitic prospective mother to consult a physician as soon as she knows she is going to have a baby. (F)
T F D 13. One test for syphilis is called the Wasserman Test. (T)
T F D 14. The syphilitic individual can sometimes successfully treat himself. (F)
T F D 15. If a husband has syphilis, his wife and children should be given a routine blood examination even though they show no sign of the disease. (T)
T F D 16. In the United States, facilities exist in almost every sizeable community for diagnosis and treatment of suspects or sufferers from syphilis. (T)
T F D 17. Many people are unaware of the fact that they are infected with syphilis. (T)
T F D 18. Diagnosis, treatment for, and cure of syphilis in adults before they become parents, prevents the transmission of the disease to their children. (T)
T F D 19. Every case of syphilis comes from some one who has syphilis. (T)
T F D 20. Syphilis is an economic and industrial as well as a social problem. (T)
T F D 21. Every person who has syphilis or gonorrhea should be required to receive suitable treatment. (T)
T F D 22. Syphilis epidemics are often started by one person. (T)
T F D 23. The source of infection of a syphilitic person should be traced. (T)
T F D 24. Respectable people never have syphilis or gonorrhea. (F)
T F D 25. Syphilis may be acquired by kissing an infected person. (T)
T F D 26. Syphilis and gonorrhea are always results of a life of crime and sin led by the individual. (F)
T F D 27. Syphilis is a communicable disease to be dealt with as any other dangerous communicable disease. (T)
T F D 28. A person with syphilis should not marry until he or she has the doctor's consent. (T)
T F D 29. Syphilis and gonorrhea are different manifestations of the same disease. (F)
T F D 30. About one out of ten people in the United States have, or have had, syphilis. (T)
T F D 31. Syphilis and heart disease are the most common causes of death and they are often related. (T)
T F D 32. The organism of syphilis may gain entrance into the body through breaks in the skin even so slight as to be unnoticeable. (T)
T F D 33. Syphilis is almost always contracted through sexual intercourse. (T)
T F D 34. During the period of the chancre, syphilis is not contagious. (F)
T F D 35. The skin eruptions, which appear in the second stage of syphilis, disappear without treatment. (T)
T F D 36. The best time for treatment of syphilis is when the organism is discovered in the blood. (F)
T F D 37. The Scandinavian countries have demonstrated the fact that syphilis can be reduced to a minor item in the category of disease. (T)
T F D 38. A blood test early in pregnancy for every prospective mother is the key to the prevention of all congenital syphilis. (T)
T F D 39. Most doctors can treat syphilis effectively, because of recent advances in research. (T)
T F D 40. The symptoms of the first stage of syphilis are usually evident. (F)

T F D 41. Treatment of syphilis should be carried out regularly and frequently. (T)
T F D 42. There is no type of immunity (not liable to infection) to syphilis. (T)
T F D 43. The parents, brothers, and sisters of a congenitally syphilitic child should be brought under medical observation. (T)
T F D 44. Syphilis affects women in much the same way as it affects men. (T)
T F D 45. Only a physician should diagnose the early evidences of syphilis. (T)
T F D 46. The cause of and methods for diagnosing and treating syphilis are now known. (T)
T F D 47. The number of cases of syphilis in our country has continued to gain steadily. (T)
T F D 48. Persons with syphilis are usually ill enough to cease work. (F)
T F D 49. Syphilis is one of the most common causes of insanity. (T)
T F D 50. As many as seventy years may elapse before serious late complications of syphilis appear. (T)
T F D 51. Syphilis causes changes in the blood which can be detected even when outward symptoms are absent or obscure. (T)
T F D 52. Complete recovery from syphilis is almost impossible if treatment is not started within a few months after the beginning of the syphilitic infection. (T)
T F D 53. Syphilis may attack or destroy any of the body tissues or organs. (T)
T F D 54. The chancre, the primary stage of syphilis, may appear on any part of the body. (T)
T F D 55. The chancre of syphilis is painless. (T)
T F D 56. Fatal effects of syphilis may be delayed as long as forty years. (T)
T F D 57. Congenital (contracted before or at birth) syphilis is more destructive and more difficult to treat than acquired syphilis. (T)
T F D 58. Syphilis is one of the chief causes of stillbirth. (T)
T F D 59. Syphilis responds readily to proper treatment. (T)
T F D 60. It takes about two years or longer to treat early syphilis and an indefinite period to treat late syphilis. (T)
T F D 61. Adequate treatment of syphilis gives assurance that the patient can no longer transmit the infection to any other person. (T)
T F D 62. Prenatal (before birth) syphilis is the largest single cause of thousands of early infant and fetal (the child before birth) deaths. (T)
T F D 63. Treatment of the pregnant, syphilitic mother is more effective than treatment given to the baby itself after birth. (T)
T F D 64. Syphilis is most contagious in its early stages. (T)
T F D 65. A single blood test is a conclusive factor of whether or not a person has syphilis. (F)
T F D 66. Treatment begun in the early days of syphilis is over 90 per cent effective. (T)
T F D 67. A spinal fluid test for syphilis is a necessary supplement, in many cases, to a blood test. (T)
T F D 68. Gonorrhea is not any more serious than a bad cold. (F)
T F D 69. Gonorrhea cures itself in time. (F)
T F D 70. The surest preventive, both of syphilis and gonorrhea, is the avoidance of promiscuous sexual conduct. (T)
T F D 71. Both gonorrhea and syphilis could be prevented in a large number of cases, if soap and water solutions were used to cleanse the sex organs *immediately* after sexual intercourse. (T)

T F D 72. Examination before marriage of both men and women, is being advocated to prevent the spread of the venereal diseases. (T)
T F D 73. The discharge of pus from the external reproductive organs is one of the symptoms of gonorrhea. (T)
T F D 74. The venereal diseases are an international health problem, as well as a national and municipal one. (T)
T F D 75. A person with gonorrhea should always sleep alone. (T)
T F D 76. Postponing sexual intercourse until marriage is compatible with good general health as well as avoidance of venereal diseases. (T)
T F D 77. Gonorrhea is one of the least serious of the infectious diseases. (F)
T F D 78. A person infected with gonorrhea should be isolated until the danger of infection is passed. (T)
T F D 79. A person cannot have syphilis and gonorrhea at the same time. (F)
T F D 80. Sexual intercourse is the only source of contraction of gonorrhea. (F)
T F D 81. Blindness, as a result of gonorrhea, has been reduced from thirty to nine per cent due to preventive measures now being taken. (T)
T F D 82. Alcoholic drinks encourage the extension of gonorrheal infections. (T)
T F D 83. One of the primary symptoms of gonorrhea is painful urination. (T)
T F D 84. Sterility is a frequent result of gonorrhea. (T)
T F D 85. Gonorrhea is as frequent in female children as it is in adults. (T)
T F D 86. Gonococci in the urethra can be killed by strong drugs that may be prescribed by the pharmacist. (F)
T F D 87. Surgical measures are often necessary to cure gonorrhea in the female. (T)
T F D 88. The dropping of silver nitrate solution in the eyes of newborn children, to prevent blindness, has become a routine procedure in almost all communities. (T)
T F D 89. The causative organism of gonorrhea may find entrance into the body through the eyes, mouth, and other structures as readily as it does through the reproductive system. (T)
T F D 90. When the discharge from gonorrhea stops, the patient is cured. (F)
T F D 91. Promiscuous and casual sexual intercourse are chiefly responsible for the wide distribution of the veneral diseases. (T)
T F D 92. Gonorrhea may be transmitted through contact with contaminated linens and wearing apparel containing moist, infectious gonorrheal discharges. (T)
T F D 93. Gonorrhea is a local disease confined solely to the sex and reproductive glands. (F)
T F D 94. Gonorrhea in women is usually more serious than it is in men. (T)
T F D 95. After adequate treatment and the disappearance of all evidences of gonorrhea, recurrence of the disease is rare. (F)
T F D 96. About four days after the gonorrheal germs get into the body, there is usually an itching and burning in the parts affected. (T)
T F D 97. At least ten per cent of all gonorrhea in the female occurs in girls under fourteen years of age. (T)
T F D 98. The frequency of gonococcal infections is at least twice that of syphilis. (T)
T F D 99. Treatment of gonorrhea becomes increasingly difficult as the disease progresses.(T)
T F D 100. Syphilis and gonorrhea are diseases of early adulthood. (T)

PART II

Directions.—Fill in all the desired information as directed below:
Place a check (√) between the appropriate parentheses.

1. ( ) Yes. ( ) No. Has the study of syphilis and gonorrhea ever been included in any of your school courses? If yes, check accordingly:
   ( ) High school
   ( ) College
   ( ) Other schools (for example.....)
2. ( ) Yes. ( ) No. Have you received any information concerning these diseases from other sources? If yes, check accordingly:
   ( ) Member (or members) of your family
   ( ) Church representatives
   ( ) Physician
   ( ) Friends
   ( ) Other persons
   Their occupation (fill in blanks):
   .....
   .....
   ( ) Books
   ( ) Magazines
   ( ) Newspapers
   ( ) Pamphlets
   From what agencies or organizations?
   .....
   .....
3. ( ) Yes. ( ) No. Would you be interested in receiving more information about venereal diseases than you now possess?
4. ( ) Yes. ( ) No. Is there a venereal disease clinic in your community?
   ( ) Don't know.

Fill in the blank spaces:

1. Age.....(years)
2. Religion.....
3. Nationality.....
4. Approximate population of your home town.....
5. Type of community (rural, industrial, or residential).....
6. Father's occupation.....
7. Mother's occupation.....

Your name is not to appear on this paper. Your grade in this course is in no way way affected by your answers to any of the questions.

Study of Correlations on Measurements of Men Students at Pomona College

By Morrill L. Ilsley, M.D.

THE following study uses data obtained while the writer was head of the Health Department at Colgate University from 1924–1928 and while he held a similar position at Claremont Colleges from 1928–1932. There will be studied approximately 1000 men students at Colgate and 1000 students from Claremont Colleges. This first study is a statistical analysis of 358 Pomona College men, using the method of partial correlation, of the physical examination given at the beginning of the freshman year, the agility test given by the Athletic Department, the illness record of each student, the scholastic attainment during the freshman year. While many of the coefficients obtained were of little interest, and insignificant in relation to the probable error, the majority of those which are significant are very interesting and instructive.

The study was undertaken for two purposes: (1) to endeavor to evaluate the work done among the men at Pomona College during the four years while the author was at Claremont Colleges; (2) to search for some measure or test whereby the probability of illness in a particular student might be predicted at the beginning of the college year.

Ten variables are used: (1) physical fitness measured in terms of a modified Schneider test figure; (2) weight; (3) height; (4) age; (5) blood pressure taken in the reclining position; (6) scholastic credits earned during the freshman year of each student; (7) the number of hours of scholastic work taken by each student during his freshman year; (8) the agility score as worked out by the Athletic Department at Pomona College. This consists of a weighted grading of the ability of the student to perform the following gymnastic exercises: (a) the student must be able to "chin' himself six times; (b) he must be able to vault chest high; (c) he must broad jump fifteen feet; (d) he must run the hundred yards in thirteen seconds. The ninth variable (9) is the illness factor. This figure is arrived at for each student by weighting each illness according to Table I. Account was taken also of the duration and severity of each particular illness. Account could not intelligently be taken of those students who followed Christian Science or the cults, the unreported illnesses, the illnesses which occurred during the summer months, those cared for by other physicians during the scholastic year, but I doubt if the latter bears much weight due to the great number of calls made on the Health Department for medical services.

The tenth variable (10) is the intelligence coefficient of these students taken at the beginning of the freshman year.

Comparing the significant coefficients of the preliminary study as reported in the American Journal of Hygiene (Volume XIX, No. 3, 753–755, May, 1934) with the significant correlations of the present study, there is a remarkable connection. It will be most interesting to see if this holds true when the Pomona women are studied.

With the number of variables chosen, it has been possible to formulate many partial correlations. A number of these are not of interest medically, but are of great interest from an educational standpoint. However, such have not been followed out in this study and only figures

TABLE I

WEIGHTED METHOD OF DETERMINING ILLNESS FACTOR

Influenza	10–20
Measles, mumps, chickenpox, and others	7
Purulent infection	5–10
Exopthalmic goiter	6–12
Neuralgia and neuritis	2–4
Other diseases of the nervous system	2–20
Diseases of the eye and annexa	2–20
Diseases of the ear	2–20
Endocarditis and myocarditis	6–12
Other diseases of the heart	6–12
Diseases of the veins	2–4
Diseases of the lymphatic system	2–4
Other diseases of the circulatory system	2–16
Diseases of the nasal fossa	4–20
Others under above title (sinus infection)	4–20
Diseases of the larynx	4–20
Bronchitis	6–12
Diseases of the mouth and annexa	6–12
Diseases of the pharynx and tonsils	7–14
Appendicitis and typhlitis	4–20
Hernia	2–4
Other diseases of the intestines	8–16
Other diseases of the liver	2–4
Diseases of the kidneys	2–4
Non venereal diseases of male genitalia	2–4
Furuncle	5–10
Other diseases of the skin and annexa	2–10
Diseases of the joints	2–6
Other diseases of the organs of locomotion	2–6
Accidental burns	2–6
Accidental traumatism by firearms	2–10
Accident traumatism by cutting or piercing instruments	2–6
Accidental traumatism by fall	2–6
Accidental traumatism by automobile accidents	2–20
Fracture	2–20

A great personal equation must of necessity enter into the estimate on each individual score. The severity of the particular illness, the amount of time lost from studies, the relation of such an illness to others in that same year—all enter into the final score.

which are of interest to medicine have been carried beyond the first order.

The physical fitness variable in the zero order gives but one coefficient of any significance (—.26±.03), which corresponds with the

ZERO ORDER COEFFICIENTS ARRANGED IN ORDER OF THEIR SIGNIFICANCE

34	Weight and height	.573±.022
78	Scholastic credits and number of hours	.405±.030
711	Scholastic credits and intelligence coefficient	.402±.030
58	Age and number of hours taken	—.305±.032
26	Physical fitness and blood pressure	—.266±.033
811	Number of hours and intelligence coefficient	.265±.033
57	Age and scholastic credits	—.238±.034
410	Height and illness factor	.221±.034
310	Weight and illness factor	.219±.034
56	Age and blood pressure	.213±.034
511	Age and intelligence coefficient	—.193±.034
810	Number of hours and illness factor	—.186±.034
35	Weight and age	.171±.035
38	Weight and number of hours	—.162±.035
311	Weight and intelligence coefficient	—.144±.035
36	Weight and blood pressure	.135±.035
39	Weight and agility score	.132±.035
24	Physical fitness and height	—.119±.035
29	Physical fitness and agility score	.108±.035
210	Physical fitness and illness factor	—.104±.035
48	Height and number of hours	—.101±.035
79	Scholastic credits and agility score	.101±.035
49	Height and agility score	.091±.035
611	Blood pressure and intelligence coefficient	—.088±.035
710	Scholastic credits and illness factor	.082±.035
911	Agility score and intelligence coefficient	—.081±.035
37	Weight and scholastic credits	—.072±.036
45	Height and age	.068±.036
46	Weight and blood pressure	.065±.036
23	Physical fitness and weight	—.064±.036
610	Blood pressure and illness factor	.058±.036
27	Physical fitness and scholastic credits	.049±.036
59	Age and agility score	.048±.036
211	Physical fitness and intelligence coefficient	.045±.036
89	Number of hours and agility score	—.042±.036
28	Physical fitness and number of hours	.042±.036
1011	Illness factor and intelligence coefficient	—.038±.036
67	Blood pressure and scholastic credits	.036±.036
69	Blood pressure and agility score	.029±.036
411	Height and intelligence coefficient	—.023±.036
510	Age and illness factor	.017±.036
68	Blood pressure and number of hours	—.011±.036
47	Height and scholastic credits	.010±.036
910	Agility score and illness factor	.005±.036
25	Physical fitness and age	—.003±.036

finding in the preliminary study that high blood pressure was not conducive to physical fitness among the men of college age.

Obviously weight and height would have the greatest positive correlation of any of the variables. But it was surprising that the heavier the man, the more apt he was to become ill: (.22±.03). One would

expect that the older the man the heavier he would be (.17±.03). Also, the heavier the man the fewer hours scholastic work he took (.16±.03). Interestingly, the heavier the man the less apt he was to have a high intelligence coefficient (.14±.03).

Height and illness are surprisingly positively correlated (.22±.03).

The older the man the fewer scholastic hours he took (.27±.03). Correspondingly the older the man the fewer scholastic credits he earned of those fewer hours (.24±.03). Without doubt the older the man, the higher his blood pressure (.21±.03). On the other hand the older the man, the lower his intelligence coefficient (.19±.03), which ties in with the findings of his mental alertness and willingness to take scholastic work.

Scholastic credits earned are most positively correlated with the number of hours of scholastic work taken (.40±.03). Also, as would be expected, there was a strong positive correlation between scholastic credits and intelligence coefficient (.40±.03).

The number of hours taken is strongly positively correlated with the intelligence coefficient (.26±.03) and is negatively correlated with the illness factor (—.19±.03). It was dsappointing that no significant correlation was found in the zero order between the agility score and the illness factor, nor between the illness factor and the intelligence coefficient.

There were many significant and interesting correlations found in the first order. Apparently if the illness factor is held constant, the negative correlation between physical fitness score and blood pressure is greatest (—.27±.03) while when weight is held constant, this correlation is smallest (—.26±.03). The strange negative correlation between weight and the number of hours taken is very much more significant when height is held constant (—.27±.03) and is least significant when physical fitness is held constant (—.16±.03). The significant correlation between the number of hours taken and the illness factor is most prominent, as would be expected, when scholastic credits are held constant (—.24±.03) and shows least significance when the agility score is held constant (—.19±.03). The taller the man, the fewer hours scholastic work are taken when weight is held constant (—.24±.03), but when the illness factor is held constant (—.15±.03), the correlation is least significant.

The taller the man the more apt is he to be ill, particularly if the agility score is held constant (.22±.03).

The positive relationship between age and blood pressure is influenced very little by any of the variables studied; weight having the least influence (.18±.03). Also, the positive relationship between weight and illness factors seems to be but little influenced by the other variables. The heavier the man the less his intelligence, particularly if

the number of hours of scholastic work are held constant (—.20±.03) and least so if physical fitness is held constant (—.14±.03). The obvious positive relationship between weight and age is but little affected by any of the variables; holding blood pressure constant gives the lowest figure (.15±.03). The negative relationship between physical fitness and height is insignificant in the zero order but, strangely enough, if the illness factor is held constant, becomes significant (—.15±.03). Likewise, there is no correlation between weight and scholastic credits in the zero order, but, if the intelligence coefficient is held constant, there is a low significant negative correlation (—.14±.03). Weight and agility score only become significantly correlated when physical fitness is held constant (.14±.03).

In the second order of partial coefficients, no added information is obtained in the height-weight relationship. The negative very significant correlation between physical fitness and blood pressure is increased when age and the number of scholastic hours taken are held constant (—.28±.03). Holding additional variables constant does not help in the obvious positive correlation between weight and age. The positive relationship between weight and agility score is helped somewhat if physical fitness and illness factors are held constant (.15±.03). On the other hand, the correlation between weight and illness factors shows a great variation. The factors which, when held constant, give the highest correlation are age and scholastic credits (.22±.03) and a close second are age and agility score (.22±.03). The factors which, when held constant, give the lowest correlation are height and number of hours taken (.09±.03), and a close second are height and blood pressure (.11±.03). None of the second order coefficients is as high as the zero order when the positive relationship between height and illness factors are considered. However, when physical fitness and intelligence coefficient are held constant, the highest positive correlation is obtained (.21±.03), closely followed by the holding of physical fitness and agility score (.21±.03). When physical fitness and weight are held constant, the coefficient is least significant (.11±.03). The fact that age and increased blood pressure go hand in hand is best shown when physical fitness and scholastic credits are constant (.24±.03); also if scholastic credits and illness factors are held constant, another interesting figure is obtained (.23±.03); of least influence in increasing the degree of correlation is weight and height (.19±.03). There seems to be a significant positive correlation between scholastic credits and increased amount of illness providing the number of hours taken and the intelligence coefficient is held constant (.18±.03), which is especially surprising since the zero order and first order show nothing of significance. The number of hours taken and the illness factor show the highest negative correlation when scholastic credits and intelli-

gence coefficient are held constant (—.23±.03) which is followed next in order when height and scholastic credits are constant (—.22±.03). The lowest figure obtained is when physical fitness and weight are constant (—.15±.03).

It was disappointing not to find some relationship which might help in finding the physically unfit before illness came, but very interesting correlations were obtained which made the study worth while.

One of the purposes of the study: to try and predict by means of some test the student apt to be ill, was unsuccessful. However, the striking results are (1) the lower the physical fitness among the heavier weight men; (2) the lack of association between physical fitness and height; (3) the heavier the man the more apt he was to become ill; (4) the positive association between height and illness; (5) lack of association between illness factor and intelligence coefficient; (6) negative association between weight and number of hours of scholastic work taken; (7) the positive association between physical fitness and height; (8) the positive association between height and illness factor.

A Critical Evaluation of the Physical Education Program of the Rural Schools of Michigan

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FOR a considerable number of years the writer has been interested in rural school children and in the programs offered them in the rural schools of Michigan. This interest was aroused during a period of teaching in one-room rural schools, and was intensified during a number of years of supervising and directing activities as Associate State Director of Physical and Health Education. With considerable attention being given to the rural school situation during these years, it was found that very little, and in many cases practically nothing, was being done for the physical and social development of these children.

If it can be assumed that education in its broadest sense should be considered as a series of experiences resulting in growth and development through which the total behavior of the individual is affected, then in the formulation of an educational program in any school, large or small, urban or rural, it would seem to be the function of the school and the responsibility of the teacher to give consideration to the all-round development of all the children. To do this the curriculum would need to include activities which are necessary and essential, not only to the mental development but to the physical and social development as well. In the belief that the inclusion of well selected and organized play activities in the daily programs of these schools would make the needed contribution to the education of these children, it was felt that attention needed to be given to the establishment and promotion of such programs, based on the particular needs of rural children.

A desire to establish criteria by which programs might be evaluated, and which might be used as a basis for recommendations for the establishing of adequate programs, was the impetus for making this study. The findings should be of help to those interested in the promotion of physical education programs in the rural schools, and to those who wish to make suggestions and recommendations to teachers, ad-

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ministrators, and to those interested in the training of teachers on the basis of the needs and interests of rural children.

PURPOSES OF THE STUDY

There were two purposes in making this study:

1. The development of principles that might be used as a basis for the building of adequate programs of organized play activities for rural schools.

2. The formulation of recommendations consistent with those principles, for guidance in the establishing of adequate programs of organized play activities for the rural schools of Michigan.

STATEMENT OF THE PROBLEM

The problem involved was twofold:

1. To establish basic criteria by which programs might be evaluated.

2. To evaluate the present Michigan programs by these criteria.

DEFINITION OF TERMS

The term "rural schools" as used in the study refers to one-room rural schools only. The grade range of the children in these schools is considered to be from the first through the eighth grade. The term "play activities" refers to the play activities usually thought of as the physical or motor type, which may be played either indoors or outdoors. This term is used in many instances in reference to "physical education" for the purpose of avoiding any assumption of the broader scope of the latter term.

METHODS AND PROCEDURES

Three types of information were necessary for this study:

1. The opinions of experts in the field of rural, physical, and general education, as a basis for the establishment of the basic criteria to be used in the evaluations.

2. Information on the practices being carried out in the Michigan schools, for the purpose of evaluating the practices.

3. Information on the best practices being carried out in the rural schools of other states, for use in formulating recommendations for the Michigan schools.

The opinions of twenty-two educational experts were secured through the use of check sheets on which these persons checked their agreement or disagreement with forty-one principles which had been formulated from ideas gleaned from published material on rural, physical, and general education.

Information on the practices being carried out in the Michigan schools was secured through the use of two forms of questionnaire. A copy of one form was sent to each of the eighty-three County Commissioners of Schools in the state. A copy of the other form was sent to

each of the 383 teachers in one-room rural schools in six selected counties of the state.

Information on the best practices being carried out in the rural schools of other states was secured through questionnaires sent to 118 teachers whose names had been suggested by the State Directors of Physical Education or by County Administrators in sixteen states.

In order to put the various elements of criteria and program on a basis by which comparisons and evaluations might be made, they were organized under five functional-element headings, namely, objectives, facilities, time allotment, activities, and leadership. Elements of the present practice in Michigan schools were compared with the same elements in the basic criteria. The evaluations were made on points in which the elements were, or were not, in line with those of the basic criteria. Recommendations were made on the basis of these evaluations.

BASIC CRITERIA

The following principles were used as the basic criteria by which the practices in the Michigan rural schools were evaluated.

A. *Objectives*

1. There should be introduced into the curriculum of traditional subjects for mental development, those activities which will give each child an opportunity for wholesome physical and social development.

2. To provide for the physical and social development of the children, a program of organized play activities should be introduced as a definite part of the curriculum in every rural school.

3. In planning and promoting a program of play activities for the rural schools, consideration should be given to the possible attainment of the following objectives: physical fitness, physical alertness, physical coordination, good posture, mental alertness, power of initiative, feeling of self-confidence, power of self-direction, sense of group loyalty, spirit of cooperation, attitude of tolerance, sense of good leadership, spirit of good followship, evidence of carry-over values, enjoyment of participation.

4. It is essential that rural children have physical activity in the form of play, as well as work, in order that there may be brought about a properly balanced physical development.

B. *Activities*

5. It is essential that the play program in the rural school include many group activities of the type that will emphasize social development.

6. The activities included in the play program in the rural school should be of the type that will bring joy and fun to the children participating.

7. The play program in the rural school should provide such a variety of activities as will enable every child to participate.

8. The following types of activity should be included in the play program: group games, relays, singing games, team games of low organization, individual contest activities, folk dances.

9. There should be instituted, for the benefit and enjoyment of all rural school children, some type of Play Day or Sports Day, in which several neighboring schools come together for an occasional day of participation in games and sports.

10. The play program in the rural school should consist of activities suitable for small groups in which it is not possible to classify the children strictly according to school grade or age level.

C. *Facilities*

11. There should be enough playground space in connection with the rural school to enable all the children in that school to participate in play activities at the same time.

12. The playground space should be leveled, drained, and surfaced so that it will be suitable for safe play.

13. The playground should be supplied with such permanent equipment as is needed for the various activities—goals, bases, etc.

14. Equipment for play activities should be furnished for the rural school through the District budget, as other equipment such as chalk, erasers, coal, etc., is furnished.

15. The following items of equipment are suitable and desirable for a rural school play program: swings, teeters, horizontal bars, jumping pit, jump standards, playground (soft) balls, baseball bats, volley balls, volley ball net, soccer balls, pitching targets, horse shoes and stakes, jumping ropes, bean bags, small rubber balls, building blocks, sand box, piano, victrola and records, game books.

D. *Time Allotment*

16. In addition to the noon and recess periods, a minimum of thirty minutes a day should be given the children in the primary grades, for play activities.

17. A definite program of play activities should be planned for the daily periods in the rural school.

E. *Leadership*

18. Opportunity for active leadership and responsibility in the promotion of the play program should be given to the pupils of the rural school.

19. The teacher of a rural school should have special preparation, which includes courses in suitable play activities, that will fit her for rural school teaching.

20. The courses in play activities for rural schools, given in teacher training institutions, should be conducted by members of the Physical Education Department of the institution, in cooperation with, and correlated with, the work of the Rural Education Department.

21. The instructors in teacher training institutions, who are conducting courses in play activities for rural teachers, should have special training or experience in rural school situations.

22. The courses in play activities given to rural teachers in teacher-training institutions should include knowledge of and participation in the following activities, on a level suitable for rural children: group games, relays, singing games, team games of low organization, individual contest activities, folk dances.

23. In addition to the knowledge of and participation in the play activities, courses for rural teachers should include: discussion of values and objectives, discussion of methods and techniques, practice in presentation, knowledge of making or securing equipment.

24. The training for rural teachers should afford a knowledge of rural conditions, and prepare the teacher to appreciate and meet the special lacks and needs in the rural schools.

25. The direction and the supervision of the play activity program should be included in the general supervisory activities of the County Commissioners of Schools.

26. The State Department of Education, which sets up the standard curriculum for the rural schools, should endorse the inclusion of a program of play activities in that curriculum.

27. There should be available from the State Department of Education, assistance in the promotion of play activities in the rural schools of the state.

28. Assistance given by the State Department of Education in the promotion of play activities in the rural schools should include suggestive program material and County Institute assistance.

29. Information on the instituting and promoting of adequate programs for meeting the educational needs of rural children should be available for County Commissioners of Schools through extension courses given by the Rural Education Departments of teacher training institutions.

CONCLUSIONS

Two significant general conclusions are brought out in the study. First, the degree to which the practices in the Michigan schools conform to the basic criteria is exceedingly low. Of a total of seventy-eight single items included in the criteria, there is conformity above 90 per cent in only one, that being the inclusion of group games in the program. Even then, although they were checked as included, no teacher reported the inclusion of a great enough number or variety of these games to give all the children an opportunity to participate in the play.

A second significant conclusion that may be warranted is that a great majority of the County Commissioners and teachers would like to

have assistance in order that they may establish and promote more adequate programs. According to the items checked and the comments made, they believe there are decided values in play activities for rural children, particularly for social development. It seems reasonable to conclude that if the teachers could be given some assistance, either in their training or in service, or both, some very fine programs would be developed throughout the state.

RECOMMENDATIONS

A. *Suggestions Concerning Teacher Training*

1. The courses in physical education for rural teachers should be planned and conducted by members of the Physical Education Department in cooperation with, and correlated with, the work of the Rural Education Department.

2. The instructors conducting physical education courses for rural teachers should have special training or experience in rural school situations.

3. The training of rural teachers should include both the practical and the theoretical phases of play activities. In addition to a knowledge of and participation in a wide variety of activities suitable for rural children, there should be an understanding of desirable objectives, of methods and techniques of presenting the activities, and ways and means of securing adequate facilities for carrying on the program.

4. Courses and activities for rural teachers should be so differentiated as to prepare them for making adaptations to the rural situation.

5. Provisions should be made, through extension courses or otherwise, for giving instruction and assistance to County Commissioners and rural teachers in service, that will help them in the promotion of adequate programs.

B. *Suggestions Concerning Direction and Supervision*

1. A program of organized play activities should be considered a definite part of the curriculum of every rural school, and should be included in supervisory plans and procedures.

2. Some plan should be instituted for the securing of adequate facilities for the conducting of play programs in all rural schools. This should include the provision of ample and suitable space and the securing of adequate equipment.

3. Provision should be made for the securing of assistance for the rural teachers in the promotion of play programs. This might be done through the distribution of material, instruction at County Institutes and other teachers' meetings, and visitations to the school by experts in the field of physical education.

C. *Suggestions Concerning Teacher Promotion of the Program*

1. A program of a wide variety of suitable play activities for rural

children, built upon educational objectives, should be incorporated into the daily teaching schedule.

2. The play activities should be well planned and organized, and adapted to the groups, so that every child will be given an opportunity to participate in many activities.

3. The time schedule for the primary children should be so arranged that they will have thirty minutes a day for play, in addition to the noon and recess periods.

4. An attempt should be made to secure information and assistance for the promotion of the play program. Courses in physical education, published material, and specialists in the field are possible sources for such assistance.

5. Suitable and adequate equipment should be secured for the play program. Much equipment may be made or improvised by the teacher and pupils, and much may be secured at very little cost.

6. Plans should be made for giving the children opportunity for occasional participation with children from neighboring schools in Play Day or Sports Day activities.

7. Pupils should be trained in and be given opportunity for assuming leadership responsibilities in the promotion of the play program.

D. *Suggestions for Additional Study*

1. It is recommended that the principles herein established as basic criteria be used as a basis for further investigation and study by those concerned with the training and direction of rural teachers. Among the problems that need further study are those concerned with the establishing of adequate courses in the teacher-training institutions, the arranging of credit and teacher-certification requirements, and the instituting of administrative procedures for the direction and supervision of the programs by the County and State Education Departments.

2. Course of Study material should be prepared for distribution to County Commissioners and rural teachers in service. This material should include detailed descriptions of suitable activities for use in rural schools, together with practical suggestions on methods and techniques of organizing and conducting play activities.

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Inter-relationships of Physical and Mental Abilities and Achievements of High School Boys

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DESPITE the fact that physical education has had a place in American schools for a century, and that the subject has been placed on the required list in an increasing number of states since 1918, we who teach are kept constantly on the defensive regarding the fundamental values of the physical activity program. While educators pay lip service to Greek ideals in the development of the dual healths, conceding the vital contributions of physical activity not only to health but also to citizenship and other fundamental purposes of education, it is still customary to shunt aside consideration of the arrangements for physical education until academic subjects have been fully satisfied, leaving only disorganized remnants of the students' time and making difficult the institution of a planned program. If a student desires to devote himself to scholarship, it is quite often true that he is "excused from physical education" with the connivance of his parents, the school authorities, and sometimes the family doctor.

Current misconceptions regarding physical education are exemplified in three commonly met attitudes. One frequently hears such a statement as, "My son is giving up sports this year, as he needs the time for his studies. I want him to make better grades." The speaker infers that physical activity affects mental achievement adversely, that time spent in sports would be otherwise used for study, and that grades in the subjects studied would be correspondingly higher.

Another common belief is that athletes, in general, are poor students, and rather stupid besides, lack of mental ability serving as a balance or compensation for excess of physical ability.[1] On the other hand, a student leader is usually referred to as "brilliant," taking for granted that it is superior mental ability which accounts for his citizenship achievement rather than great physical vitality, abundant health, some unmeasured quality of character, or some established attitude of service or self-sacrifice.

Particularly distasteful is the more or less subtle criticism of physical

[1] This opinion is not supported by such studies as that of Burtt and Nichols. See "The Intelligence of Varsity Athletes," *American Physical Education Review*, 29 (1924) 125.

education expressed by those who obtain permission for students who have been ill or who are not strong to be "excused from physical education," as if only those who are already strong and healthy are benefited by exercise. If this practice were limited to abstinence from the strenuous sports program or to such schools as offer a narrow range of activities suited only to the physically adept, one might concede the validity of the judgment. Such, however, is not the case.

What are the facts regarding these current criticisms? Are they substantiated by facts? Is there any way in which we may weigh the evidence apart from mere personal prejudice, and discover from objective data what, if any, are the values of physical activity, and which students are most likely to be benefited by exercise?

Studies previously made upon this general subject have been hampered by narrowness of scope in that they considered "varsity athletes" only, and, as a rule, too few cases to give reliable norms.[2] Further, as a consideration of abilities and achievements, the data gathered regarding each individual were too meager to give basis for conclusions. A boy might, for instance, show low athletic ability and high scholarship, supporting the belief that the correlation of these two items is negative. An examination of the records, however, might show that the boy is crippled as the result of a childhood illness, that he has otherwise better than normal health, that he takes part in such physical activities as he is able to enjoy, that he has an active and alert mind, and that he is an unselfish and unassuming citizen. While this boy might rate low in an objective test of athletic ability or one based on varsity competition, it is obvious that within his capacities his physical achievement is high, and that no conclusion may be reached regarding him without considering several important items of his record.

THE DATA

The present study is based upon a compilation of records of 432 boys of a specific high school, the records covering from one to four years of high school attendance.[3] Norms for each item recorded were established, and the data examined in detail to determine whether there are any definite relationships between the characteristics. Records of certain active and inactive groups were obtained for purposes of comparison with the average and with each other.

Items related to each individual boy and recorded on his case record card were obtained from the general administrative, health, physical education, and student body offices. No student was conscious that the measures were being taken except as they were taken normally in the regular routine of school life. This precluded any tendency for the

[2] An exception is the study of Angus, *Athletic Journal*, 17:5, 28.

[3] The case records include all boys enrolled in the Palo Alto (California) High School during the school year 1935-1936, except 37 whose records were too incomplete to have value.

measures to be affected by the enthusiasm of the investigator's hope that the research would yield a specific conclusion. The number of cases and the highly complicated interrelationships of the data made well nigh impossible the unconscious intrusion of prejudice in the recording of the data or the selection of the items to be recorded.

No attempt will be made to justify any of the methods used in estimating either abilities or achievements. None of them is completely satisfactory, but all are generally accepted measures of the factors which in this study they are presumed to measure, and all are used in Palo Alto schools as a means of estimating those specific factors. Subjectivity is the chief objection to the measures used, only the decathlon being a completely objective measure with scores based on time, distance, or number of successful completions. The number of cases comes so close to the five hundred suggested by Rugg as ordinarily furnishing reliable norms that one may assume that the law of averages will balance the results to fairly objective terms.[4] This is particularly true in the case of seniors, whose four-year experience will have brought them into contact with a wide variety of teacher, subject, and incidental experiences. Reliability of results is further checked by frequency graphs to determine whether the results show normal distribution curves. Any variation from the normal is noted in this discussion in order that it may be considered in interpreting the results of the study.

Measures of mental ability and achievement used were the Terman Group Test and academic grades respectively. The frequency graphs in both of these particulars varied from the normal in that more than one-half of the students are above the presumed average of 100 I.Q. and received more than one-half of their grades above the presumed average of C.[5] The fact that the two graphs tend to correspond, however, indicates apparent reliability of the measures, as does also an examination of the grade and I.Q. spread by classes.[6] That is to say, the class having the highest percentage of I.Q.'s above average has also the highest percentage of grades above average.

Measurements of physical ability and physical achievement were obtained by the use of a specially devised decathlon in which the skills tested were those fundamental to the Palo Alto activity program, the perfect performance score being determined by the average of the three highest performances of high school students during an experimental year. The skills were distributed proportionately throughout the sports and self-testing program, and the decathlon record of a student in his freshman year was used as a measure of his physical ability, im-

[4] Harold Rugg, *Primer of Graphics and Statistics.*

[5] In explanation of this fact, attention should be called to the nature of the community, which is made up largely of college and school people, whose children would be expected to rate high in native mental capacity.

[6] For relation of school marks to intelligence, see R. H. Burgert, *Journal of Applied Psychology*, XIX, 606–614.

provement in each successive year, weighted according to the increased difficulty of achievement at the higher levels, being taken as his physical achievement. As might be expected, these distribution curves show more clearly than any other that the measure used is reliable, for the standards set are based upon the tested abilities and achievements of comparable groups in the specific community studied. It was interesting to note that the physical achievement curve ran from minus 75 to plus 225, indicating that in physical education the person who stands still actually travels backward. This backward progress was, in all but one case, an accurate indication of a bad physical or mental condition, also borne out by other items in the case records concerned.

Citizenship achievement was measured by a point award scale used in student body records, a definite number of points being awarded for each of a large number of listed services and activities. The frequency graphs concerned with this measure show it to be the least reliable of all used, both in its distribution curve for the entire group and by comparison of the graphs of the four classes. Because the measure is some indication of citizenship, however, more or less removed from the personal judgment of individuals, it seems to have some value in throwing light upon the more definite data.

Health was an item for which no objective measure was discoverable. Height and weight measured annually over the entire period of school attendance constituted an objective measure when considered in relation to age. Extreme variation from the normal and progress of the record toward or away from the normal were noted as significant. These data are included, not as a measure of health, but as a sideline commentary. Records from the physician's annual examination card were tabulated, but gave only a listing of structural defects, functional disturbances as a rule being ignored. Complete confidential files of individual medical histories would have been most valuable, but would even then have been incapable of comparison because of the widely differing financial status of the students and the consequent wide variation in the accuracy of the reports.

Three other items were entered on the case records: physical education grade, athletic participation, and record of leadership positions held.[7] Athletic participation was recorded on the basis of membership in any interscholastic sports squad. Strictly speaking, every participant in physical education was an athlete, inasmuch as game activities are the basis of the program. By limiting to the interscholastic squads, we eliminate three classes of boys: those physically unfit for the more strenuous competition, those who must earn a living by working after school hours, and those who either prefer not to play or are not

[7] Obtained from the point award record of citizenship described above.

permitted to do so. The lines between the unfit, the indifferent, and the parentally vetoed are hard to draw, but the small number of cases definitely identifiable rewarded careful study.

CENTRAL TENDENCIES AND BASIC RELATIONSHIPS

The average boy in the group studied was 16 years and 8 months of age, with an I.Q. of 109. He was, for his height of 5 feet 6½ inches, a few pounds underweight at 129½. More than 31 per cent of the group varied 10 per cent or more from the presumed normal for age and height, and the average boy grew at the rate of 1.7 inches a year. Academically his average was 62.25 per cent (a low B) and he had probably failed once, the average being .67 failures per student.[8] Physically he rated in ability at 480 points out of a possible 1000 in the decathlon, and his achievement was 53½ points a year, slightly more than 5 per cent in each of the 10 events. There is very little chance that he has held even a minor leadership position, as only one in six is a leader, but six out of ten boys were members of interscholastic sports squads and are therefore classed as athletes. (See Table I.)

Examination of the records of the four classes reveals only slight differences in average I.Q., physical ability and achievement, academic grade level, and citizenship service.[9] Variations in athletic participation were slight, but lower percentages of participation were accompanied by a higher number of failures per year in academic subjects, even

TABLE I

CENTRAL TENDENCIES OF SCHOOL AND CLASSES

	Entire Group (432)	Freshmen (81)	Sophomores (129)	Juniors (86)	Seniors (136)
Age	16.8	15	16.1	17.2	17.11½
I. Q.	109	112.3	107.3	109.2	109.2
Weight	129½	119	120.5	136.9	138
Height	66½	63.9	66	67.3	67.8
No. overweight	50	9	17	13	11
Per cent overweight	11	11	13	15	8
No. underweight	86	16	27	20	23
Per cent underweight	20	20	21	23	16
Annual Growth	1.7	1.9	1.9	1.6	1.6
Athletic participation (per cent)	57.1	52	60	62	65
Physical education grade	77.6	89.2	77.2	72.8	73.92
Physical ability	480	453	505	491	469
Physical achievement	53.5		47.3	51	58.7
Academic grade	62.25 (B—)	63.5 (B)	59.5 (C)	65.75 (B+)	61.95 (B—)
Average no. of failures	.67	.4	.74	.49	.8
Leadership record	11	1	1.2	2.8	30.8
Citizenship record	55	52	44.5	50	70

[8] A, 80-100 per cent; B, 60-80 per cent; C, 40-60 per cent; D, 20-40 per cent; F, 0–20 per cent.

[9] The variations in I.Q. by classes corroborate the findings of Almack, Benjamin, and others that students of highest and lowest intelligence drop out of school, both extremes of I.Q. being found in the freshman class.

when the I.Q. level is higher. Rate of growth is very rapid for the first two years, slowing down in the third and fourth years. In the third year, this slowing down is accompanied by a great irregularity of weight distribution, and in the fourth year there is a general leveling off toward the normal. While citizenship service is rendered about equally by members of the various class groups, leadership opportunity is very irregular and seems to be concentrated in the senior year.

After establishing the characteristics of the average member of the entire group and checking by means of the classes to determine whether the characteristics remained constant in the smaller groups, the next step was to arrange the data in group intervals to determine whether the relationships of the characteristics would again remain constant. Using the I.Q., an educationally accepted measure, as the basis, five groups were established. Averages for these five groups were compared with the previously established norm, and the variations scanned to determine whether there were significant interrelationships between the items and whether there might be progressive tendencies apparent in the study of the groups. (See Table II.)

According to the evidence disclosed in the arrangement of the data described above, there are certain general tendencies in the relationships between the characteristics. Academic grades tend to rise as the I.Q. level rises.[10] Age tends to be less as the I.Q. grows higher, indicating a general acceleration of the higher mentality groups. This should be borne in mind, as some of the tendencies may therefore be attribut-

TABLE II

CENTRAL TENDENCIES OF SCHOOL AND MENTALITY GROUPS

	Entire Group (432)	Superior (82)	Above Average (174)	Average (77)	Below Average (60)	Low (9)
Age	16.8	16	16.4	17.25	17.95	17.2
I. Q.	109	128	112	101	89.5	76
Weight	129.5	126	129	132	134	127
Height	66.5	65	66.4	67	67	67.5
No. overweight	50	10	21	9	10	0
Per cent overweight	11	12	12	11	17	
No. underweight	86	15	39	18	10	2
Per cent underweight	20	18	22.5	22	17	22
Annual growth	1.7	2.01	1.8	1.45	1.2	.5
Athletic participation (per cent)	57.1	54	57	59.5	63	33
Physical educ. grade	77.6	76.08	79.2	73.6	74.04	78.4
Physical ability	480	432	461	512	532	547
Physical achievement	53.5	73	53	41	49	17.6
Academic grade	62.25 (B—)	70.5 (A—)	63 (B)	57.4 (C)	50.25 (D+)	52.25 (C—)
Average no. of failures	.67	.3	.6	.88	1.2	.33
Leadership record	11	22.7	14.5	3.4	1.1	0
Citizenship record	55	113	67	46	44.7	14

[10] Raw scores would have been preferable to I.Q. in this connection, but were not usable because of wide variations in dates of testing.

able to age rather than to I.Q. Chief among the characteristics corresponding roughly with age are height and weight. Rate of growth corresponds, to I.Q. rather than to age, however, as the low ability group, who break the regular trend in age tendency by being young, are the slowest growing of all with .5 inches a year average compared with 2.01 inches for the superior group.[11] Physical ability shows a trend which is the reverse of the I.Q. but which corresponds to age. Physical achievement, leadership, and citizenship service show a tendency to correspond with the general intelligence level.

An interesting fact disclosed by this arrangement of the data was that the group most likely to break the regularity of the trend was the low mentality section. Some unmeasured factor not tabulated in this study is apparently stimulating this group to a higher level of achievement than might normally be expected. Whether this influence is one of character traits, of purpose in acquiring an education, or of the necessity for competition with students of vastly superior native ability might be established either by further attention to the case records or by an additional study of a psychological nature.

Using the Spearman rank method for determining correlation, the data were next examined to discover to what extent the central tendencies persist in considering individuals within a given mental ability class. In this section of the study only the five definitely measured characteristics were usable: mental ability, physical ability, mental achievement, physical achievement, and citizenship achievement. (See Table III.)

Correlations between abilities and achievements showed, on the whole, certain progressive tendencies. Though ability was a reliable predicter of success of large groups, for the individual within the group that ability was not so reliable, for correlation between I.Q. and grades

TABLE III

CORRELATIONS OF TRAITS BY I.Q. GROUPS*
(Senior Class)

	I.Q. 121–147	I.Q. 106–120	I.Q. 96–105	I.Q. 81–95
Mental ability and mental achievement	+.24	+.06	—.12	—.09
Mental ability and physical ability	—.19	—.11	+.16	+.27
Mental ability and physical achievement	+.03	+.17	+.08	+.12
Mental ability and citizenship service	—.15	—.07	+.07	+.29
Mental achievement and citizenship service ..	+.59	+.33	+.11	+.54
Mental achievement and physical ability	+.24	+.09	+.16	+.26
Mental achievement and physical achievement	+.07	+.25	+.12	+.76
Physical ability and physical achievement..	—.08	—.28	+.03	+.03
Physical ability and citizenship service	+.21	+.18	+.18	+.54
Physical achievement and citizenship service	+.23	+.14	+.30	—.08

* Four groups only are used in this tabulation because the senior class contained no members with I.Q. below 80.

[11] I.Q.'s for the five groups established were: superior, above 120; above average, 106–120; average, 96–105; below average, 81–95; low, below 81.

varied from +.24 in the superior group to —.12 in the average group. Correlation of I.Q. and physical achievement, on the other hand, was consistently positive for all groups, varying from +.03 to +.17. Citizenship service and I.Q. showed correlations varying from —.15 in the highest mental ability group to +.29 in the lowest group. Physical ability and citizenship service also showed positive relationships from +.21 to +.54. Strangely enough, physical ability was least reliable as a predicter of physical achievement, varying from +.03 to —.28.

When one considers the correlations of the various types of achievement, however, he finds that all relationships but one are positive, and that these correlations produce the highest figures in the table. Grades and citizenship correspond to a degree varying from +.11 to +.59. Grades and decathlon improvement show correlations varying from +.07 to +.76. Decathlon and citizenship show correlations from +.14 to +.30, except in the case of the lowest I.Q. group, who show a negative correlation, —.08, possibly because of the fact that the majority of these boys work outside of school hours and have no opportunity to earn citizenship service credits.[12]

Achievement in one field is therefore a far more reliable prediction of individual achievement in another field than is ability. Ability, on the other hand, is not a consistent indication of ability in another field nor of achievement in its own field or in any other field.

STUDIES BASED ON ATHLETIC AND PHYSICAL EDUCATION

Using senior records only because of the greater reliability of the four-year record, the mass of data was next broken down to determine whether there were apparent relationships between athletic participation and the other items entered on the case records, and whether the various degrees of physical activity, as measured by cooperation in the general physical education program, had any bearing on health and achievement. (See Table IV.)

1. *Effects of Athletic Participation.*—The average athlete of the senior class is one month younger than the average class member. He is two pounds heavier and nearly an inch taller. His I.Q. is two points higher. Extreme variations in weight from the normal (more than 10 per cent) occur in only 17 per cent of athletes as compared with 24 per cent of the class as a whole. In physical ability and achievement the athlete is above the class average. The greatest variation from the class average, however, is in the athlete's academic grades, which are 5 per cent higher than those of the class group. He fails in his studies .5 times in his high school career, while the average senior fails .8 times. In leadership and citizenship the athlete is also well above the class average.

Participators in team athletics, as compared with those in individual sports, are interesting in that the team athlete's I.Q. is slightly lower

[12] Citizenship point award records are based entirely on service in school, ignoring home and community life.

and his grade average slightly higher. He is also less likely to be underweight, though more likely to be overweight. All athletes, whether underweight or overweight, showed a tendency to progress toward the norm for age and height.

Meanwhile, what of the boy out of sports either by his own choice or that of his parents? He is older by four months than the class average. His I.Q. is identical with that of the athlete. He is lighter in weight and lower in height than the athlete, and 45 per cent of the members of the group vary 10 per cent or more from the normal for

TABLE IV

COMPARISON BASED ON ATHLETIC PARTICIPATION

	Senior Class	All Athletes	Team Athletes	Indiv. Athletes	Out by Choice	Out for Work
Age	17.11	17.10	17.11	17.10	18.3	18.4
I.Q.	109.2	111	107	116	111	102.2
Weight	138	140	141	138	138	129
Height	67.8	68.6	69	68	68	67
No. overweight	11	3	3	0	3	1
Per cent overweight	8	3.5	6		15*	6
No. underweight	23	12	7	5	6	6
Per cent underweight	16	14	13	15	30*	36*
Annual growth	1.6	1.7	1.55	1.92	1.51	1.3
Phys. educ. grade	73.92	83.32	81.36	86.4	50.68	74.16
Physical ability	469	513	546	458	438	415
Physical achievement	58.7	62	60	65	56	49.5
Academic grade	61.95 (B—)	65.35 (B+)	62.15 (B)	70.4 (A—)	54.25 (C—)	57.7 (C)
Average no. of failures	.8	.5	.67	.3	1.7	1
Leadership record	30.8	41	26	65	2.7	4
Citizenship record	70	100.4	93	112	19.8	14

* Apparent discrepancies in percentages in relation to total number of the group are caused by the fact that only a part of these two groups have had school physical examinations.

height and age. In physical ability, he is somewhat below the class average and considerably below the athlete. Academically the picture is most interesting of all, for this boy who is completely free outside of school hours for study, and possessing a higher I.Q. than the average senior, might be expected to have good grades. Instead, his grade average is 8 per cent below the general and 13 per cent below the athlete group. In academic failures he averages 1.7, compared with the class average of .8 and the athlete average of .5. His leadership record, meantime, is practically non-existent, and his citizenship service is very low, less than one-third of the class average and less than one-fifth of the athlete's.

Examining the data related to boys out of athletics because of work, we find the working boy older by five months than the class average, lower by seven points in I.Q., lighter in weight by nine pounds, though less than an inch lower in height.[13] Only 6 per cent of this group are overweight, but 36 per cent are underweight! In physical ability, this

[13] Boys both working and taking part in athletics were not considered separately, although they represent a large group.

boy is far below the average. These two latter facts should counteract the long-standing error of opinion that boys who work are of the husky type, and that work contributes as much as does play to physical growth. In a more primitive day when work was of a different sort this may have been true. Today the type of work done by the average high school boy is evidently not of the health- or physique-building variety. Academically, the boy who works is 4 per cent below the class average, though 4 per cent above the average of boys who neither work nor play on interscholastic squads. The boy who works is more likely to be a leader than the boy out of athletics by choice, but only one-tenth as likely to be a leader as is an athlete.

A comparison of participants in the several school sports was made, but disclosed no unusual facts except that the student of very high I.Q. was likely to choose an individual rather than a team sport, and that academically and physically the team athlete seemed to be benefited more by his competition than was the individual athlete. Throughout, however, it was obvious that in all respects the records of the athletes, whether team or individual, were better than the records of non-athletes, the working boy suffering more by the physical comparison and the non-working boy showing greater inferiority scholastically and in citizenship.

Reasons for the scholastic superiority of the athlete are not apparent in this study. Probably the fact that he must keep up his grades in order to compete is a contributing factor, borne out by the fact that 67 per cent of the athletes' failures occurred during a season when their particular sport was not being played. That is to say, a football player was twice as likely to fail in the second semester as in the first semester, when football was being played. The physical records indicate that superior health may contribute to the energetic attack which produces higher grades.[14] Curtis has suggested that it is the attitude of mind developed through play which produces efficiency of mental effort because of the "complete absorption in the thing at hand, entire forgetfulness of self." [15] Other investigations have indicated that the boy who participates in sports actually spends more hours in study than does the boy who leads an inactive life.[16] Whatever the reason, the evidence indicates that the parent who keeps a boy out of athletics for the sake of his studies is likely to be making a mistake, for it is probable that he would be doing better work if he were allowed to play.

2. Effects of Physical Activity.—Disregarding athletic participation, except for purposes of comparison, we next examine the records of six groups of students not entirely normal either in physical condition or in physical activity. These groups were: students not taking physical

[14] Cf. Elmer Berry, *Philosophy of Athletics*, 56.
[15] Henry S. Curtis, *Education Through Play*, 58.
[16] Leo Elliott, "Survey of Leisure Activities of Louisiana State University Men" (thesis).

education one or more years of their high school career, students with health records showing physical defects, a small number of students with extreme physical defects but voluntarily taking part in physical education, students resisting either physical education or corrective measures, students showing either rising or falling grades in physical education, and those under- or overweight.

Two of these groups, the physically defective and those underweight or overweight, showed no great differences from the average in their records. The underweight student was a trifle more likely to be an active citizen than the overweight boy. Students with physical defects were very slightly below the class average in every respect except I.Q. and academic averages. The I.Q. of this group is identical with that of the athlete, but the academic average is lower and the number of failures higher.

Students who at some time in their high school career had been out of physical education showed a general inferiority to the class average, very slight in I.Q., greater in physical ability, and greatest in the three types of achievement. The academic averages were 5 per cent below the class average and therefore 10 per cent below the average of athletes; failures in academic subjects were double those of the general group, more than three times those of athletes. This group is, by the way, the only group studied which is overweight. As the majority of the group had been out of physical education only a part of their high school careers, the records were examined to disclose that eleven had better records while in physical education, one had a worse record, and five had records showing no appreciable variations.

The most interesting and complete contrast in the entire study was that between the group who resisted physical education and the group who chose to participate in spite of physical defects of extreme nature.[17] In spite of an I.Q. of 111, identical with that of the athlete, those resisting physical education show an academic average more than 11 per cent below athletes, 6 per cent below the class average, and failed an average of four times as often as did athletes.[18]

Students voluntarily cooperating in physical education despite such handicaps as osteomyelitis, scarred lungs, heart lesion, or the lack of arms or hands, had an average I.Q. of 106. Their physical ability also averaged lower than the general group, but their physical achievement higher. Their average academic grade was 78 per cent, higher than any other group in the entire study, and exactly 24 per cent higher than the average of the group just discussed, though the native mental ability of the latter group is rated as 5 points higher. There is not one academic failure on any record in this group, one-half of whom are leaders. Citizenship service is double that of the average class member.

[17] Resistance to physical education included: refusal to be examined, refusal to wear glasses, refusal to take showers or to dress for gym, etc.

[18] Physical figures unavailable because of non-cooperation.

The only case of negative physical achievement in this little group just discussed is particularly interesting. In all other case records in the study, a minus physical achievement was accompanied by erratic academic records and no achievements in citizenship. This particular case, however, is that of a boy born with arms half length and only two fingers at the end of each arm. He might well have been sensitive at play, as were two of the students who were excused from physical education because of mal-function of the glandular system. Instead he neither asked nor gave quarter in the rough and tumble contacts of the physical activities program, and ended up by being commissioner of boys' athletics in his senior year. He was frequently referred to as "brilliant," though his I.Q. was 107. His first decathlon record, which he preferred to take in spite of his handicap, was low, and he was not only unable to improve that record, but his annual progress was minus 5. One can hardly agree, however, that in his case this represents backward progress. His average grade was 82 per cent (an A—), and his annual citizenship record was nearly three times that of the normal boy. He occupied, as has been noted, the highest athletic leadership position which the school had to offer.

A final comment on the value of physical activity may be made after the examination of the records of students showing rising or falling physical education grades. A rise in the latter grade was accompanied by an average academic rise of nearly 10 per cent. Falling physical education grades were accompanied by a drop of about 5 per cent in academic average.

CONCLUSIONS

Findings of this study include some which are merely corroborations of other studies. These have great value, however, in establishing the reliability of the independent findings of this research. Among the corroborative findings are: I.Q. is a fairly reliable predictor of success in academic grades, though more reliable for general ability groups than for individuals within those groups; rate growth is more generally related to I.Q. than to any other factor except age; athletes are not low in mental ability, though individuals of very high I.Q. frequently forego athletics. The latter statement is modified in this study to exclude individual sports and one team game, basketball.

Within the limits of an I.Q. group, this study finds physical ability a more reliable predictor of academic standing than is relative I.Q. At the low I.Q. levels, some unmeasured quality seems to influence achievement of all sorts in the individuals who persist in school attendance.

Athletic participation seems to be beneficial to the student in a number of different respects. The athlete grows faster and is less subject to extreme variations in weight. Contrary to general opinion, athletics seems to have a greater effect in correcting the underweight than the overweight condition. All corrections of extreme variations of either type were made by members of the athlete group.

The athlete is not only superior in mental ability as measured by I.Q., but more superior as measured by academic averages, and still more superior as measured by number of academic failures.

An unexpected result of this study is that aspect related to the boy who works, as he seems to be handicapped to some extent academically and to a great extent physically. Play activity of a physical nature, no longer a part of the life of the average family at home, is evidently still a necessity for normal development of boys of high school age, and that need is not met by the physical activities of a work life. Work, however, is by no means so great a handicap to a boy's academic success as is a deliberate choosing not to participate in competitive activity.

Results of this study as based on physical activity without consideration of athletic participation indicate that engagement in such physical activity is definitely beneficial both to health as indicated by height and weight in relation to age and to achievement, both academic and physical. This beneficial result is apparent both in the comparison of groups made up of different individuals and by comparing the records of the same individuals who at various times do and do not participate. The value is particularly high in cases of the physically handicapped. The greatest contrast in the entire study is that between students who resist physical education and those who request special permission to participate. The inferiority of the group who resisted physical activity was characteristic in every respect except native mental capacity, and the superiority of the handicapped was also persistent in every trait except I.Q., which was lower than the general average.

It may be said that results indicated are in part a matter of attitude, and that forced activity would not be so beneficial. This is true, but the attitude of parents and educators goes far toward determining the attitude of children. Friendliness toward and belief in the play spirit by educators and the general public would remove the prop of sophisticated superiority which is the refuge of the non-conformist who evades physical activity and physical competition for some more nervous satisfaction. The joy of mental and physical health and the pleasure of natural social contacts would sell the physical activity program to the boy himself if he would only give it a chance.

It may also be said that the values indicated by this study are attainable only in case the program is arranged to meet all degrees of physical need and in case the athletic program is administered with properly conceived educational objectives and the participation of an entire student group in mind. This also is true, but no school should ever have a physical activity or athletic program conceived or administered in any other way. The values of a program are measured by its potential power. Failure to attain those values or corruption of the force to produce negative results is a criticism of the administration of the program.

A Study of Age, Weight, and Height of Entering Freshmen at the University of Illinois

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MANY studies have been made within the past few years of the changes in weight and height of our population. Among these have been several concerning the changes in entering college students. One excellent study, by Chenoweth[1] at the University of Cincinnati, finds students entering at an earlier age than was the case twenty years ago and being taller and heavier than were their predecessors. He concludes that this increase is not due entirely to improved social and conomic position. Bowles[2] also finds Americans getting larger. According to Mills[3] and the Metropolitan Life Insurance Company[4] there is some feeling that the tendency to increased height and weight is slackening.

The figures presented here are taken from the records of the University of Illinois Health Service and cover the compulsory entrance examination of students for the years indicated. An index number is computed for each yearly average figure. It will be seen that there has been some decrease in the age of the students entering the University of Illinois but not much change in weight and height. This shows that the Illinois students are participating to some degree in the national gain in weight and height.

On the other hand, too much value must not be placed on these figures as the number is too small and the period covered is too short.

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[1] L. B. Chenoweth, "Increase in Height and Weight and Decrease in Age of College Freshmen," *Journal of the American Medical Association*. 108:5. 1937.

[2] G. T. Bowles, *New Types of Old Americans at Harvard and Eastern Women's Colleges* (Harvard University Press 1932).

[3] C. A. Mills and L. B. Chenoweth, 108:354, (January 30, 1937). "Is the Human Tide Turning?" Human Biology 10:547. 1938.

[4] "American Women Getting Thinner," *Statistical Bulletin Metropolitan Life Insurance Company* (1939), 20:11.

MEN

Academic Year Exam.	Number Measured	Index	Average Age Yrs.	Index	Average Height (in.)	Index	Average Weight (lbs.)
1917–18	282	1.02	19.04	.999	68.14	1.01	142.37
1918–19	2050	1.01	18.88	.979	65.68	.968	136.74
1919–20	1624	1.04	19.47	.964	65.7	.948	133.8
1920–21	1239	1.013	18.95	1.0	68.2	.970	136.86
1921–22	1504	1.01	18.88	.971	65.19	.958	135.11
1922–23	1429	.994	18.58	.992	67.69	.970	136.92
1923–24	1366	1.01	18.9	1.002	68.42	.974	137.22
1924–25	1850	1.005	18.8	.999	68	1.002	141.4
1925–26	2075	1.00	18.71	.994	67.75	1.02	143.8
1926–27	2242	1.00	18.73	1.0	68.2	1.005	141.8
1927–28	1875	1.00	18.72	1.01	68.96	.998	140.7
1928–29	1894	.987	18.44	1.02	69.12	1.018	143.27
1929–30	2029	.997	18.63	1.01	68.85	1.00	141.6
1930–31	2281	.9875	18.46	.998	68	.995	140.2
1931–32	1785	.988	18.48	1.01	69	.990	139.15
1932–33	1421	.978	18.3	.996	67.9	.990	141.4
1933–34	1554	.987	18.44	1.015	69.2	.993	140
1934–35	1929	.990	18.50	1.016	69.24	1.02	143.72
1935–36	2184	.990	18.49	.989	67.42	1.017	143.21
1936–37	2486	.992	18.55	1.00	68.44	1.03	145.68

WOMEN

1919–20	521	1.056	19	.987	62.25	.993	117.3
1920–21	477	1.11	20	.999	63	1.06	125.4
1921–22	488	1	18	1.03	65.2	1.058	124.9
1922–23	535	1	18	.984	62	.982	116
1923–24	658	1	18	.973	61.4	.967	114.1
1924–25	654	1	18	.997	62.8	1.01	119.6
1925–26	818	1.017	18.3	1.01	63.6	1.00	118.2
1926–27	808	1	18	1.00	63.1	.985	116.5
1927–28	772	1.02	18.4	1.00	63.2	.998	117.9
1928–29	750	.995	17.9	1.01	63.9	1.008	119
1929–30	879	1.01	18.2	.989	62.4	1.00	118.1
1930–31	769	.995	17.9	1.01	63.9	.990	117
1931–32	724	.955	17.2	.973	61.4	.975	115.1
1932–33	545	1	18.0	1.01	63.6	1.02	120.6
1933–34	647	.984	17.7	.999	63.0	.994	117.3
1934–35	784	.984	17.7	.999	63.0	1	118.1
1935–36	785	.984	17.7	1.01	63.6	1.024	121
1936–37	867	.989	17.8	1.01	63.8	1.016	120

Comparison of the Rogers Test and the City College of New York Physical Proficiency Test as Bases for Classifying Students for Activity in Physical Education

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ANALYSIS OF THE PROBLEM

THE purpose of this study is to determine the relationship between the Rogers Test and the City College Physical Proficiency Test in classifying students for activity in physical education. The assumption is that if a high positive correlation is found to exist between them, one test may be substituted for the other.

The Scope of the Problem.—The study necessitates the use of the City College Physical Proficiency Test (hereafter called P.P.T.) and the Rogers Physical Fitness Test (hereafter called R.T.). The former consists of five events administered to every student by the College Hygiene Staff in an indoor gymnasium. The events included are:

1. *Running Broad Jump*—The jump coming after a 50-foot run onto a take-off board 2″ x 12″ x 3′ long. The distance is measured from the edge of the take-off board to the point where the back heel first touches the mat. One warm-up and one trial is given.

2. *Bar Vault for Height*—The stunt consists in grasping the bar with the forward grip while facing the bar, and springing upward and over the bar without any part of the body touching it. Two trials at each height are permitted; the bar is started at 3 ft. 6 in. and raised two inches at a time after each series of trials.

3. *Track*—Consists of running around the oval track in the Main gymnasium of the City College which is 102 yards around. The time is recorded in fifths of a second.

4. *Dips*—The dip starts from a full arm extension on the parallel bars; elbows are bent fully and then straightened, thus raising the body. This constitutes one dip. The score for this event and the following event is recorded as the number of dips, or "pull-ups," halves not being counted.

5. "Pull-ups"—Executed by chinning the high bar, the hands facing away from the body in gripping the bar.

The Rogers tests were administered by the writer with the assistance of one or two members of the City College Hygiene Staff; the students acting as recorders. A description of the Rogers tests may be

obtained from his original treatise for the Doctorate.[1] The test was given as prescribed by Rogers with the exception of the "pull-ups," in which the high bar was used instead of the "rings."

The P.P.T. is used at City College for the purpose of homogeneous grouping of students in physical education while the R.T. is suggested for similar use and thus employed, in many New York secondary schools.

The above tests were administered to two incoming freshman classes from which all of the experimental data were gathered.

DATA AND TREATMENT

The Procedure Step by Step.—The scores of each student on his P.P.T. as conducted by the College Hygiene Staff were recorded. Each score was then transmuted to a point score from tables of values used by the department.* The point scores of the five events were added to give a composite physical proficiency score because each activity is given equal weight. The R.T. was administered to one group at each gymnasium session, the groups consisting of from twenty to thirty students. The lung capacity, chinning, and dipping tests were administered by either of two members of the College Staff who had previously been informed about, and had practiced administering, these tests according to the standardized directions. At this time the age, and height and weight which had been previously measured by the writer in the routine medical exams, were recorded for the students. All of the scores were recorded on data sheets prepared by the writer. The students were assigned arbitrary numbers for expediency in identification throughout the study. The total number of students whose scores were used amounted to one hundred and seventy-five, all obese cases and incomplete records were discarded.

Treatment of the Data.—A Strength Index was computed for each student according to the method suggested by Rogers in his original study.[2] The Strength Indices and Physical Proficiency scores were grouped into frequency distributions and a coefficient of correlation was computed by the Pearson Product Moment method. Similarly the total scores of five events of the R.T. (eliminating the two identical constituents or dips and "pull-ups") were correlated with the opposite

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[1] F. R. Rogers, "Physical Capacity Tests in the Administration of Physical Education," Contributions to Education No. 173 Columbia University, New York; 1926, pp. 4.

* The tables had been prepared by Mr. Ehrlich, of the department, who used the scores of about five hundred representative cases for the preparation of each of the five tables. The tables were computed from frequency distributions by basing the scores on the S.D. of the distribution. The scores were to range from 0 to 100. The zero point being taken at 3σ below the mean, the 100 point at 3σ above the mean, and the mean score at 50. This range of 0 to 100 was then divided by five to give points of 1 to 20 for the various raw scores of the events.

[2] F. R. Rogers, *op. cit.*, pp. 50.

scores on the P.P.T. Mean scores were computed for each event of the R.T. and the P.P.T.

For purposes of better comparability between any student's scores on both tests, the Strength Indices and Physical Proficiency composite scores of every student were converted to T scores by use of the formula $T = 50 + \frac{10}{\sigma}(X - M)$.[3] As a check on the previous correlation, a coefficient of correlation was computed using the T score distributions.

Finally, in an attempt to offer a more graphic illustration of the meaning of the coefficient of correlation between the two tests ($.60 \pm .03$ in both instances), the writer adopted a technique described by Orleans.[4] Since it is unnamed in his text it will be called for the purposes

"PREDICTIVE BOXOGRAM"

T SCORES ROGERS STRENGTH INDICES

T SCORES PHYSICAL PROFICIENCY TEST	(7) 59.4–86	(6) 55.1–59.3	(5) 51.1–55	(4) 47.9–51	(3) 43.9–47.8	(2) 39.5–43.8	(1) 24–38.4
(7) 61.1–78	11	5	5	2	2		
(6) 55.5–61	9	3	5	2	2	2	2
(5) 51–55.4	3	9	4	3	2	1	3
(4) 46.8–50.9	1	5	4	6	6	4	
(3) 42.7–46.7	1	1	1	5	7	7	3
(2) 39–42.6		1	3	5	2	6	8
(1) 28–38.9		1	3	3	4	5	9

[3] G. M. Smith, "A Simplified Guide to Statistics," (New York: Farrar and Rinehart, Inc., 1938) 38.

[4] J. S. Orleans, "Measurement in Education," (New York: Thomas Nelson and Sons, 1938, appendix C pp. 416–420.

of this study a "predictive boxogram." The first step in the procedure is to divide the 175 students into an arbitrary number of groups. In this case the writer chose to use seven groups which was not merely an arbitrary number. This would place twenty-five students in each group and would approximate the actual procedure that would take place in the physical education program at City College. (If for instance one hundred students came to the gymnasium at the eleven o'clock hour, there would be four instructors assigned and the class would be divided into four homogeneous groups of twenty-five students, on the basis of their Physical Proficiency scores. An attempt is made to keep the groups down to this number but administrative difficulties sometimes necessitate groups of as many as 35 to 40 students.) Using the T score distributions for both tests the score at the 14.3 percentile was obtained, the score at the 28.6 percentile, the 57.2 percentile score, the 71.5 percentile score, and the 85.8 percentile score. These scores divide the group into sevenths. Next a twofold table, which appears below, was prepared and each student located in a box on the basis of his T score in both tests as would be done in an ordinary scattergram. By means of this table it is shown how many students are in the highest seventh of both distributions, how many are in the highest seventh of one distribution and in the second highest seventh of the other, how many are displaced two or more groups, etc. The results of this procedure appear in the following chapter.

FINDINGS FROM THE DATA

Results Summarized.—Following is a tabulation of the mean scores obtained in this study along with figures from Rogers' [5] study. It is of interest to note the similarity of results obtained in many of the tests, although in a few events Rogers' results are distinctly higher. This is not unusual for the opinion of many of those who have used Rogers' tests is that his mean scores are unusually high for the level given.

MEAN SCORES

Item	Rogers	This Study
Age	16.5	16.8
Height	67.2	68
Weight	131	138
Right Grip	96.06	103.5
Left Grip	83.3	95.9
Back Lift	308	260
Leg Lift	516	412
Lung Capacity	232	254
Dips	6.5	4.2
Pull-ups	7.7	5
R.B.J.	13–^{2}	12
Strength Index	4–^{6}	4–^{5}
Vault	1360	1248

[5] F. R. Rogers, *op. cit.*, pp. 8.

The correlations between both tests using the original composite scores, and the T scores, gave a coefficient of .6 ± .03 which is a seemingly significant correlation. The range of the R.T. was 770 to 1920, with a S.D. of 189. The range of the P.P.T. was 16 to 95 with a S.D. of 51. A coefficient of correlation of .22 ± .04 was obtained between the total scores of five events of the R.T. and the complete P.P.T.

From the figures in the "boxogram," reading across the central diagonal, it is evident that 45 out of the 175 students or 26 per cent would be in the same seventh of the group whether classified on the basis of one or the other tests. Similarly by reading across the diagonal, just above the central diagonal, it can be determined that 34 cases fall one group lower on the R.T. classification than on the P.P.T. Classification, and 34 cases are one group lower on the P.P.T. classification than on the R.T., making a total of 68 cases or 39 per cent that are displaced one group. In like manner it is shown that 16 cases are two groups lower on the R.T., and 18 are two groups lower on the P.P.T., for a total of 34 cases or 19 per cent displaced two groups. Five cases are three groups lower on the R.T., and 8 cases are three groups lower on the P.P.T., for a total of 13 or 7 per cent displaced three groups. Seven cases are four groups lower on the R.T., and 5 cases are four groups lower on the P.P.T., for a total of 12 or 7 per cent displaced four groups. Two cases are five groups lower on the R.T., and 1 case is five groups lower on the P.P.T., for a total of 3 or 2 per cent displaced five groups. The similarity of numbers of cases falling the same number of groups lower on the respective classifications indicates that each test has about the same predictive efficiency for the other.

It is further shown from the table that in the seventh or highest group there are 11 out of a possible 25 students that fall in that group on the basis of both tests. This may be interpreted as indicating that the chances are 44 out of 100, that an individual who would be in group seven on the basis of one test, would fall in group seven on the basis of the other. Similarly, the chances are 12 out of 100 for group six, 16 out of 100 for group five, 20 out of 100 for group four, 28 out of 100 for group three, 24 out of 100 for group two, and 36 out of 100 for the lowest group. It is of interest to note that the greatest possibility of falling in the same group exists in both extreme groups, which may be explained by the fact that the range of scores for these groups is larger than for any of the others.

CONCLUSIONS

Interpretation of Results and Discussion.—The significance of the coefficient of correlation of .6 as illustrated by the "boxogram" and the figures therefrom, makes it clear that we definitely may not substitute one test for the other for the purpose of classifying students in physical education. In view of the fact that the R.T. has been used

with satisfaction in a great many schools in New York,[6] while the P.P.T. has as yet been untried except at City College, some might conclude from the above findings, that the latter is not as acceptable for classifying students for activity in physical education. The writer wishes to take issue with such a conclusion on the basis of the following.

The writer wishes to point out that the R.T. is principally a measure of strength except for the lung capacity item. Consequently to employ a measure of strength as the basis for classification in the physical education program which for the most part consists of gymnastic and athletic activities, is to classify by inference, the inference being derived from the fact that Rogers' study showed a correlation of .81 between strength and the Athletic Index.[7] This over an age range of 10.58 to 20.42[8] would thus tend to give a higher correlation than the college age range used in this study namely, 15.1 to 21.1. On the other hand the P.P.T. is a measure of achievements in activities which are more closely allied to the physical education program than are the strength activities of the R.T. Thus the employment of the P.P.T. enables classification on the basis of demonstrated ability close to and in the activities, rather than on ability related to the activities; this to all intents and purposes would seem to make the P.P.T. the more desirable of the two.

The writer is aware of the inconclusive nature of the experimental results of this study concerning the relative values of the two tests as measures for classification in physical education. But the low predictive value of the Rogers Test for the Physical Proficiency Test and vice versa would seem to warrant further examination of these two tests for their use as measures for classification in physical education.

A study is now in progress at the City College of New York to check the usefullness of the P.P.T. as an instrument for classification.

The writer hopes that the present study will inspire subsequent research to examine the efficiency of the Rogers Test as a measure for purposes of classification in physical education.

Acknowledgment.—The writer wishes to take this opportunity to express his appreciation to Professor F. A. Woll, Professor J. Dailey, and Mr. Purcell of the Hygiene Department of the City College of New York for their invaluable cooperation in the many details of the study and for the liberty granted the writer in the use of the freshmen classes for the gathering of the data.

Sincere thanks are extended to the members of the Department who so willingly and capably assisted in the administration of the tests. To Dr. Krakower is due an expression of thanks for his many suggestions in the use of statistical techniques.

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[6] The State Department of Education, Health and Physical Education Division, Physical Education, Bulletin No. 17, 1929.

[7] F .R. Rogers, *op. cit.*, pp. 30.

[8] ———, *op. cit.*, pp. 9.

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*Abbreviations have been used to indicate the following: M.T., Master's Thesis; Ph.D., Doctor of Philosophy Dissertation; Ed.D., Doctor of Education Dissertation.

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BOOK REVIEWS

THE NEGRO IN SPORTS. Edwin Bancroft Henderson. (Washington, D.C.: Associated Publishers, Inc., 1939) 371 pages, $2.10.

The newsworthy performances of a number of prominent athletes have recently served to direct considerable popular attention to the athletic abilities of Negroes. In his well illustrated and timely volume, Mr. Henderson states concisely what the record shows as to the achievements of Negroes in boxing, track and field, football, basketball, baseball, tennis, weightlifting, crew, wrestling, golf, fencing, lacrosse, soccer, bicycling, riding, swimming, bowling, hockey, horseshoe pitching, and marbles. The accomplishments of women and girls as well as men and boys are included.

The legion young who draw inspiration from the feats of their elders will enjoy the simple language and good photographs. The reader with a special interest who wants to know quickly what has been done in a particular line will appreciate the brief historical account woven into the chapters on each sport. The writer or speaker who wants at hand the facts on outstanding performances will find them assembled for him. The physical educator and sociologist will find value in the references to factors responsible for differential progress in the various sports, such as amateur and commercial promotion, racial discrimination, and the development of independent athletic organizations in Negro schools and colleges. The historian and civic leader will be interested in the citations of wholesome interracial competitions in several fields. The scientist who would inquire into the physical basis for excellence in sports, particularly into the reasons for an alleged prominence of Negroes in certain lines, will find useful the lists of significant performances in text and appendix, and those photographs which show physical characters clearly.

The diversity of interests of these potential readers suggests directions in which future editions of the book may be expanded. On performers of the highest caliber significant biographical data would be welcomed by many. Because those photographs are of greatest value which best show the physiognomy and physique of their subjects, we may expect that certain of the photographs will be replaced. That of Joe Louis, for example, reveals little of the anatomical features of one of the hardest hitters of all time. On the other hand, those of Sam Langford and John Henry Lewis are excellent in this respect. The pictures of Kenny Washington and Bernard Jefferson are action shots representing more incarnate ferocity than human beings you'd like to know.

There are omissions, of course, and places where emphasis may require reshading. It is remarkable that these are as few as they are, in an initial work of this kind.

Particularly commendable is the objective tone in which the book is written. There is no spirit of racial boastfulness or resentment. The "Introduction" and the closing chapter on "The Meaning of Athletics" show clearly that this recital of deeds and doers is intended as evidence of the constructive value of sports in a democracy for building good citizens and promoting mutual goodwill among them.

Mr. Henderson brought to his task the superior equipment of a facility in writing, a lifelong experience is athletics as performer, coach, official, and physical director, and a constructive social perspective developed through years of

activity in civic affairs. Through the high quality of his volume he has placed in his debt a large public who have long realized the need for such a book.

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The Dartmouth Book of Winter Sports. Edited by Harold Putnam for the Dartmouth Outing Club. (New York: A. S. Barnes & Company, 1939) 315 pages, $3.00.

Up to 1910 Dartmouth College, at Hanover, New Hampshire, among the hills of the upper Connecticut River and remote from any large city, had little that was distinctive by way of recreation during the long northern winter.

Under the enthusiastic leadership of Fred Harris, class of '11, supported by the college paper, a program of winter sports was proposed and initiated. Following this the Dartmouth Outing Club, aided by benefactions from believers in winter outdoor activities, assumed active promotion until today this organization stands foremost among college winter sports participants. Its program has been written up in the new and attractive volume entitled *The Dartmouth Book of Winter Sports.*

The section on skiing by Walter Prager, appearing also in the Barnes Dollar Sports Library Series, includes about ninety pages of detailed instruction such as: pre-season training, equipment, elementary progression, techniques of various turns, jumps, types of racing, etc., and is an excellent introduction to this sport. Physiologists will be interested in his discussion of "dead point," second wind, and respiration. The chapter concludes with notes on the selection and care of equipment and the layout of courses for cross-country races, while the downhill and slalom receive but brief consideration.

Skating, presented by Harold Putnam and Dwight Parkinson, also appears as a separate volume in the Barnes Dollar Sports Library Series. The introductory chapter on the history of skating merits attention. This section covers plain and special skating, followed by selection and care of various types of skates, shoes and clothing. Then comes speed skating, training, stunts, turns, and race strategy. The use of gelatine is suggested as a factor in increasing endurance and there is a pronounced attitude indicated by the endorsement of the dictum "You cannot drink or smoke and be a good skater."

Parkinson presents fundamentals of figure skating, advanced school figures, free skating, and dancing. This is one of the best chapters in the book. Outside and inside edges forward and backward are well portrayed; starts are described with excellent clarity and minute detail, while advanced figures such as change of edge, threes, single and double, loops, circles, brackets, rockers, and counters are well outlined. The chapter on the care of ice surfaces is particularly commendable. It includes types of skating areas, clearing ice surfaces, and ground plan layout for different skating areas.

The winter carnival is Dartmouth's unique contribution to winter sports. Thousands attend this annual event to share or witness the intercollegiate contests outdoors in skiing, snowshoeing, skating, and ice hockey, and indoors in basketball and swimming. But more highly regarded than any of the above is the wonderful snow sculpture. Outdoor evening shows and the crowning of the "Queen of the Snows" constitute a truly gala occasion.

Details of the organization of this carnival are a splendid example of undergraduate cooperation. The most unique contribution is the plan, construction, finishing and spotlighting of the "snow statuary." The subjects are varied from a heroic figure of Eleazer Wheelock, the founder of the college, to an elaborate stage for the outdoor evening set.

Winter mountaineering contains many cautions and suggestions on expedition planning, personal equipment, moving camps, climbing techniques, and mountain dangers; while winter camping includes selection of camp sites, construction of shelters, snowshoe construction, and repair of snowshoes and skis. Winter trapping and dead falls add a utilitarian

touch to the general recreational emphasis.

Concluding this comprehensive text, with its fine format, adequate illustrations by photos and line drawings, is an enthusiastic chapter on the part played by Dartmouth's representatives in expeditions in competition both at home and abroad.

G. B. Affleck
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Motion Pictures in Physical Education. Thurston Adams. (New York: Bureau of Publications, Teachers College, Columbia University, 1939) 55 pages, $.90.

This small booklet contains essential and pertinent information for the physical educator. It points out the vast possibilities for the use of the motion picture as a teaching aid in this field and then shows in an interesting and practical manner how a class was taught the tennis serve by methods based on two instructor-made films.

The monograph includes four chapters and a bibliography. Chapter I describes the place of motion pictures in physical education, wherein the author quotes statements on the local use of films in sports, points out studies that have been completed on the use of motion pictures in physical education, gives reasons why the film medium is so adaptable to teaching physical activities, and after describing the sources of available motion pictures in this field, concludes with a section dealing with "the significant possibilities" of instructor-made films.

The second chapter is devoted to an excellent description of the production and use of experimental motion pictures at the University of North Carolina. The equipment used, the prepared script for filming the "expert" film, and techniques employed in filming the students involved in the experimental study, are clearly described. This is followed by a description of methods employed for showing and analyzing the films in the classroom.

Chapter III should prove invaluable to the physical education department which is planning to purchase equipment necessary for producing instructor-made films. It gives a complete description of the necessary equipment needed to film and show sports activities, and since it was written for the particular benefit of physical educators, and takes into consideration the peculiar requirements of this specific field, it fulfills a need not usually recognized by motion picture literature in general education.

The concluding chapter lists twenty observations and suggestions for using motion pictures in physical education, and since they are a result of the author's own experience, they are pertinent, challenging, and very practical.

The motion picture committee of the American Association for Health, Physical Education, and Recreation highly recommends this booklet as a significant contribution to the field.

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Cowboy Dances. Lloyd Shaw. (Caldwell, Idaho: Caxton Printers, Ltd., 1939) $3.50.

To the many Americans who have been assailed by the feeling that they should know where they had heard before the current dance favorite, "Put Your Little Foot Right There," it may be a comfort to remember that the tune is the good old Varsouvianna, a favorite of Dr. Lloyd Shaw whose article, "Bring 'Em Back Alive," appeared in a recent issue of the *Journal of Health and Physical Education.*

In *Cowboy Dances* you can find an excellent description of the Varsouvianna, complete with appealing and helpful illustrations. Although his call is "Sweep, point, step . . ." you will have no trouble dancing it with "Put your little foot. . . ."

The book, in the words of its author, is "a very personal, chatty sort of manual" which sets forth in an entertaining and informative style quantities of lore about our Western country dances—simple squares, old favorite round dances,

more squares, reels, and calls for all the dances elbow each other on the pages. Good action photographs and diagrams that can be understood help to answer any questions. A glossary and index complete the careful organization of the whole.

As if the names of the dances weren't intriguing enough—Birdie in a Cage, Lady Go Halfway Round Again, Take Her Right Along, Pokey Nine, Double Bow Knot—Lloyd Shaw's calls complete our undoing. Fancy trying to sit still while you read:

"Up and down and around and around,
Allemande left and Allemande aye,
Ingo, bing, six penny high,
Big pig, little pig, root hog or die."

The only trouble with the book is that it must be read while dancing!

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ADMINISTRATION OF HEALTH AND PHYSICAL EDUCATION. Jesse Feiring Williams and Clifford Lee Brownell. (2nd ed.; Philadelphia: W. B. Saunders Company, 1939), 634 pages, $3.00.

This book presents up-to-date, authoritative evidence and standard practices in the administration of health and physical education. The authors have combed the field and obtained a store of priceless information to suit particular needs. This second edition incorporates a new and valuable chapter, "The Administrator at Work," and also an abundance of recent data. The chapters on "The Meaning of Health and Physical Education," "State Responsibility," and "Healthful School Living," have been altered in the light of latest trends.

The authors have succeeded in stripping administration of its non-essentials; dispelling the clouds of administrative confusion, pointing the way to overcoming of administrative inertia; promoting clarity of thought and disseminating useful information for the benefit of the student, the teacher, the physician, the nurse, the school administrator, and the administrator of health and physical education.

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THE PHYSIOLOGY OF EXERCISE. A Textbook for Students of Physical Education. James Huff McCurdy and Leonard A. Larson. (3rd ed., Philadelphia: Lea and Febiger, 1939) 349 pages, $3.75.

As its subtitle indicates, this purports to be a textbook for students of physical education. Such a treatise may, ideally, be expected to have and to realize two main objectives. First, it should convey an understanding, so far as present-day knowledge will allow, of the behavior of the organs and the systems of the body under the stress of physical exercise. To be complete, this understanding should encompass not only the individual behavior of the parts of the body, but their interaction and the mechanisms which control and integrate their interaction. The second objective should be the application of this knowledge and theory to the more efficient and intelligent performance of exercise. Not only are established practices to be interpreted in the light of physiological principles, but modifications are to be proposed and possibilities probed. This objective is the more difficult of achievement for it requires firsthand and expert technical knowledge of practical athletics and gymnastics in addition to the tools of the specialist in physiology—a combination of attributes which is seldom if ever embodied in any one individual.

Needless to say there is no single textbook in existence which fulfills both of these objectives, although there are several which adequately approach the first. Responsibility for the lack of adequate treatment of the practical aspects of exercise physiology lies, however, not with the writers of textbooks but with physical education itself, for, as McCurdy and Larson have pointed out, physical education as a profession has not yet

been placed upon a thoroughly scientific basis.

Regardless of the implications of the foregoing paragraphs, it is evident from the plan of their book that Doctors McCurdy and Larson must have had both of these purposes of a text of exercise physiology in mind, and perusal of the work itself will convince the reader that they have traveled far toward the accomplishment of these purposes. The book is divided into three sections which deal with the general effects of exercise upon bodily functions, the effects of special types of exercise upon bodily function, and with methods of indicating efficiency of bodily functions.

In the first section, after dealing with the relationship of physiology to physical education, the authors classify the various types of exercise. The effects of exercise in general are then considered in relation to the circulatory, respiratory, and neuromuscular systems. Each topic is considered in detail and the statements which are made are based almost exclusively upon published works to be found in the literature and for which citations are given.

In the second section specific forms of exercise are analyzed with reference to the peculiarities or special features characterizing the reaction of the body to each. For instance, one may learn from this section the effect of American Rugby football upon heart rate and weight, the incidence of albuminuria in basketball players, or the effect of golf upon the blood pressure. Separate chapters are devoted to aquatics and to aviation and mountain climbing. Valuable features of this section which have not appeared in the previous editions of the text are chapters dealing with the special subjects of physical education for women and with exercise for people over forty years of age.

The third section deals chiefly with various aspects of the application and interpretation of various tests of bodily ability and of physical fitness, including the McCurdy-Larson Organic Efficiency test which is presented in detail. The general subjects of the validity of such tests and their place among the tools of the physical educator are given exceptionally sane and well-balanced consideration.

The evaluation of this book must depend largely upon the angle from which its usefulness is viewed. The book is outstanding in the wealth of information which it supplies and the thoroughness with which the literature in its field has been reviewed, there being almost thirteen hundred citations in its bibliography. As a reference book and source book, therefore, for student and investigator alike it is of exceptional merit.

On the other hand, there are certain features of the work which, in the opinion of this reviewer, will limit its usefulness as a textbook for undergraduate students. Too often experimental data or the conclusions of authors cited are presented with no attempt at interpretation, and frequently with no apparent plan governing their sequence. Such a discourse may lack meaning to the average undergraduate student for whom interpretation of facts is fully as important as the facts themselves and who habitually, but quite legitimately, looks to those of greater experience and special training for guidance in such interpretation.

In scope the material presented is adequate except in two particulars. The very important topics of fatigue and of training are very briefly treated in a portion of one chapter occupying some twenty-three pages.

In concluding this review it may be well to recall the statement made in the opening paragraphs that there is at present no completely adequate textbook on the physiology of muscular exercise. And, notwithstanding the freedom with which certain alleged weaknesses have been described, the treatise of McCurdy and Larson will undoubtedly continue to occupy its position among the leading works in its field.

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